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Compilation of Theses Abstracts

December 2003



Office of the Associate Provost and Dean of Research
Naval Postgraduate School

PREFACE

This publication contains restricted abstracts (classified or restricted distribution) of theses submitted for the degrees Doctor of Philosophy, Master of Business Administration, Master of Science, and Master of Arts for the September 2003 graduation. Classified and restricted distribution abstracts are listed on the NPS SIPRnet.

This compilation of abstracts of theses is published in order that those interested in the fields represented may have an opportunity to become acquainted with the nature and substance of the student research that has been undertaken. Copies of theses are available for those wishing more detailed information. The procedure for obtaining copies is outlined on the last page of this volume.

For additional information on programs, or for a catalog, from the Naval Postgraduate School, contact the Director of Admissions.

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an annual publication of research projects and publications, are also available on-line.

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INTRODUCTION

Mission

The Naval Postgraduate School (NPS) was established to serve the advanced educational needs of the Navy. The broad responsibility of the school is reflected in its stated mission:

Increase the combat effectiveness of U.S. and allied armed forces and enhance the security of the U.S.A. through advanced education and research programs focused on the technical, analytical, and managerial tools needed to confront defense related challenges of the future.

To fulfill its mission, the Naval Postgraduate School strives to sustain excellence in the quality of its instructional programs, to be responsive to technological change and innovation in the Navy, and to prepare officers to introduce and utilize future technologies.

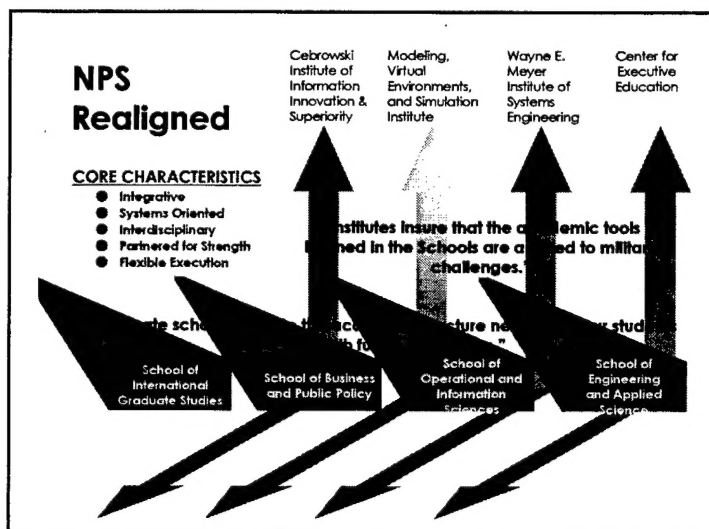
The research program at NPS exists to support the primary mission of graduate education. Research at NPS:

- maintains upper division course content and programs at cutting edge;
- challenges students with creative problem solving experiences on DoD relevant issues;
- advances DoN/DoD technology;
- solves warfare problems; and
- attracts and retains quality faculty.

Academic Programs

To meet its educational requirements, the Navy has developed a unique academic institution at the Naval Postgraduate School through the use of specially tailored academic programs, and a distinctive organization trying academic disciplines to naval and joint warfighting applications.

The Naval Postgraduate School has aligned its education and supporting research programs to achieve three major goals: 1) academic programs that are nationally recognized and support the current and future operations of the Navy and Marine Corps, our sister services, and our allies; 2) institutes that focus on the integration of teaching and research in direct support of the four pillars of Joint Visions 2010 and 2020 and their enabling technologies; and, 3) executive and continuing education programs that support continuous intellectual innovation and growth throughout an officer's career.



INTRODUCTION

Programs of Graduate Studies at NPS are grouped as follows:

Graduate School of Operational and Information Sciences

- Computer Science
- Electronic Warfare Systems International
- Information Systems and Operations
- Information Systems and Technology
- Information Warfare
- Operations Analysis
- Operations Logistics
- Software Engineering
- Defense Analysis

Graduate School of Engineering and Applied Sciences

- Combat Systems Science and Technology
- Electronic Systems Engineering
- Meteorology
- Meteorology and Oceanography
- Operational Oceanography
- Oceanography
- Reactors/Mechanical Engineering
- Naval/Mechanical Engineering

Graduate School of Business and Public Policy

- Systems Acquisition Management
- Resource Planning and Management for International Defense
- Financial Management
- Transportation Management
- Defense Systems Analysis
- Systems Acquisition Management
- Information Systems Management
- Defense Systems Management (International)
- Contract Management
- Manpower Systems Analysis
- Transportation Management
- Leadership Education and Development
- Acquisition and Contract Management
- Program Management
- Material Logistics Support Management
- Supply Chain Management

School of International Graduate Studies

- National Security and Intelligence
 - Middle East/Africa/South Asia
 - Far East/South-East Asia/Pacific
 - Western Hemisphere
 - Europe/Russia/Central Asia
- Civil-Military Relations
- Defense Decision Making and Planning
- Homeland Security Leadership Development
- International Security: Post Conflict Security Building

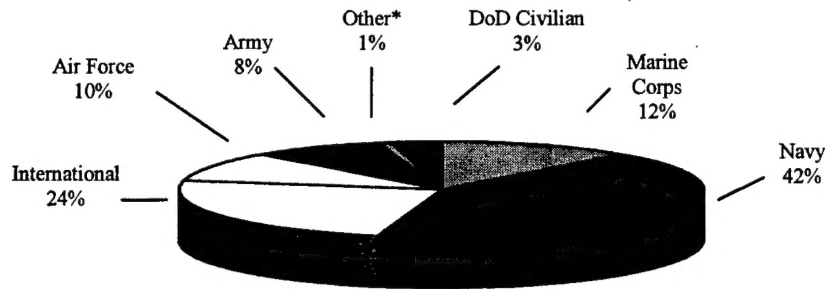
Interdisciplinary Curricula

- Modeling, Virtual Environments, and Simulation
- Product Development
- Systems Engineering and Analysis
- Undersea Warfare
- Space Systems Engineering
- Space Systems Operations
- Systems Engineering Management

Students

The student body consists of U.S. officers from all branches of the uniformed services, civilian employees of the federal government and military officers and government civilian employees of other countries. Resident degree/subspecialty student population for December 2003 is shown in Figure 1 on the following page.

INTRODUCTION



**Figure 1: Resident Degrees/Subspecialty Student Population for December 2003
(Total Enrollment: 1,491)**

*U.S. Coast Guard, U.S. Army National Guard, U.S. Army Reserve

Academic Degrees

Although the curricula are tailored to address defense requirements, they are developed within the framework of classical academic degrees, meeting the highest academic standards. Each curriculum leads to a master's degree; however, additional study can lead to either an engineer's degree or the doctor's degree. Below is a listing of the degrees offered at NPS:

Master of Arts Degrees

National Security Affairs
Security Studies

Master of Business Administration

Master of Science Degrees

Applied Mathematics
Applied Physics
Applied Science
Astronautical Engineering
Combat Systems Technology
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Engineering Science
Information Systems and Operations
Information Technology Management
Meteorology and Physical Oceanography
Leadership and Human Resource Development
Management
Materials Science and Engineering
Mechanical Engineering
Meteorology
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Physics
Product Development
Program Management
Software Engineering

Space Systems Engineering

Space Systems Operations
Systems Analysis
Systems Engineering
Systems Engineering Management
Systems Technology

Engineer Degrees

Astronautical Engineer
Electrical Engineer
Mechanical Engineer

Doctor of Philosophy

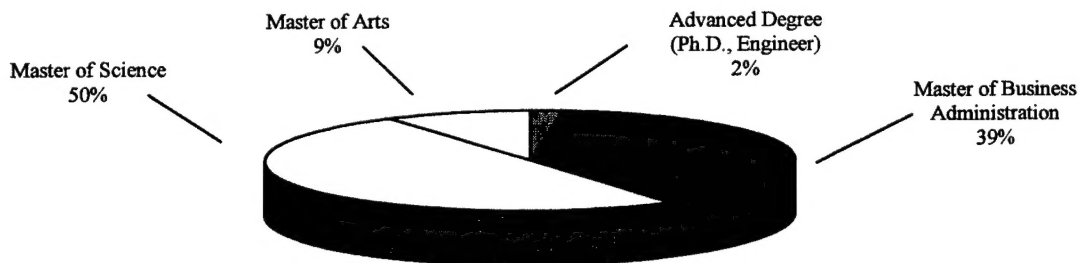
Astronautical Engineering
Applied Mathematics
Applied Physics
Computer Science
Electrical Engineering
Engineering Acoustics
Information Science
Mechanical Engineering
Meteorology
Modeling, Virtual Environments, and Simulation
Operations Research
Physics
Physical Oceanography
Software Engineering

Doctor of Engineering

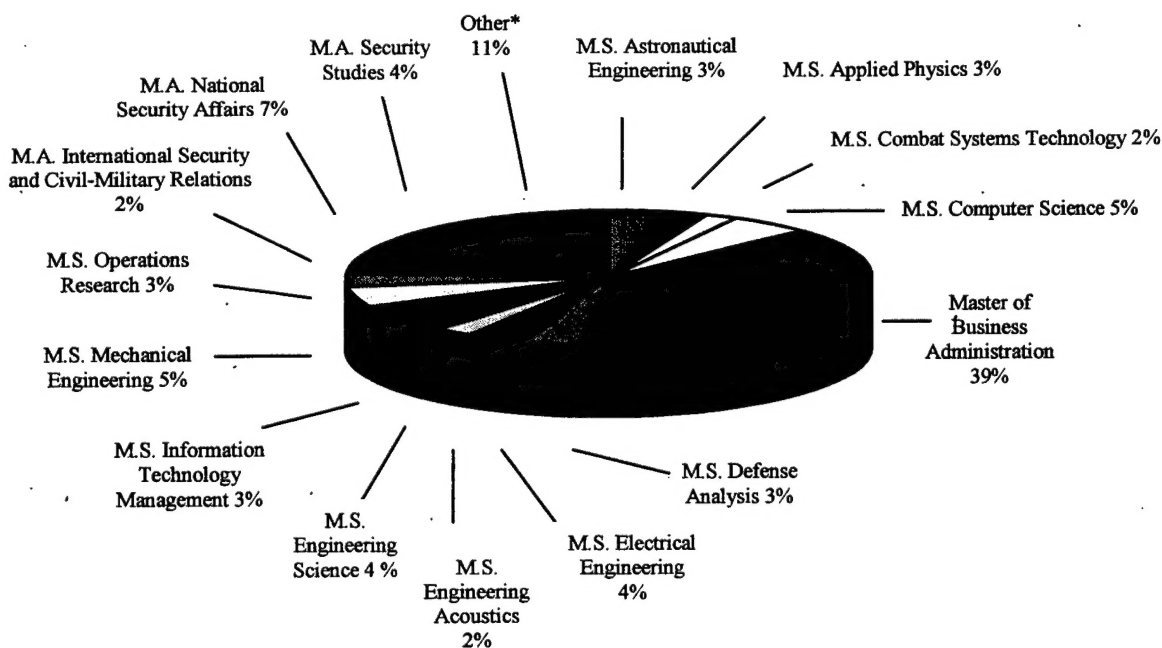
Astronautical Engineering
Engineering Acoustics
Mechanical Engineering

INTRODUCTION

There were 224 degrees conferred in December 2003. Figure 2 indicates the distribution of degree type; Figure 3 indicates the degree conferred.



**Figure 2. Distribution of Degree Type
(224 Degrees Conferred)**



**Figure 3. Degrees Conferred in December 2003
(224 Degrees Conferred)**

*Ph.D. Meteorology (1); Ph.D. Physical Oceanography (1); Ph.D. Software Engineering (1); Astronautical Engineer (1); M.S. Aeronautical Engineering (3); M.S. Applied Science (1); M.S. Contract Management (1); M.S. Management (2); M.S. Information Systems and Operations (1); M.S. Leadership and Human Resource Development (1); M.S. Meteorology and Physical Oceanography (1); M.S. Physical Oceanography (1); M.S. Modeling, Virtual Environments, and Simulation (3); M.S. Physics (1); M.S. Product Development (1); M.S. Program Management (1); M.S. Software Engineering (1); M.S. Systems Engineering (2); M.S. Systems Technology (1).

INTRODUCTION

Thesis

The thesis is the capstone achievement of the student's academic endeavor at NPS. Thesis topics address issues from the current needs of the Fleet and Joint Forces to the science and technology that is required to sustain long-term superiority of the Navy/DoD.

Students, with their faculty advisors, provide a very unique capability within the DoD for addressing warfighting problems. This capability is especially important at the present time when technology in general, and information operations in particular, are changing rapidly. Our officers must be able to think innovatively and have the knowledge and skills that will let them apply technologies that are rapidly being developed in both the commercial and military sectors. Their unique knowledge of operations, when combined with a challenging thesis project which requires them to apply their focused graduate education, is one of the most effective methods for both solving Fleet/Joint Force problems and instilling the life-long capability for applying basic principles to the creative solution of complex problems.

NPS is unique in its ability to conduct classified research. Restricted theses are available on the NPS SIPRNET.

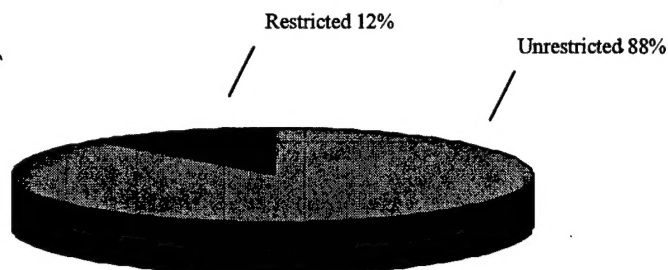


Figure 4. Classification of Theses

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ADVANCED DEGREES

**Doctor of Philosophy
Astronautical Engineer**

DOCTOR OF PHILOSOPHY

CONVECTIVE BOUNDARY LAYER PARAMETERIZATIONS IN HIGH-RESOLUTION MESOSCALE MODELS

Michelle K. Whisenant-Lieutenant Commander, United States Navy
B.S., Florida Institute of Technology, 1990
M.S., Naval Postgraduate School, 1999
Doctor of Philosophy in Meteorology-December 2003
Advisor: Qing Wang, Department of Meteorology

In this dissertation, the issue of grid resolution and the sub-grid scale (SGS) parameterizations in a mesoscale model are addressed. Particular concern relates to increasingly high-resolution mesoscale atmospheric numerical models, in that sub-grid scale parameterization of atmospheric processes becomes unclear when the grid resolution becomes comparable to the length scale of the phenomenon. Observational analysis is performed to better understand the scales of turbulence in various environmental conditions. The ability of the U.S. Navy's current Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPSTM) to perform accurately within the resolvable scales and to accurately represent the boundary layer turbulence mixing when the resolution is high is analyzed, using a case study of boundary layer roll vortices in cold air outbreak conditions over the Japan/East Sea. Based on results from the above analysis, the existing turbulence parameterization is modified towards more realistic representations of the turbulent processes over a relatively wide range of grid resolution. This modification within COAMPSTM results in a more realistic simulation of the BL structure compared to observations, with improved spatial variability in the mean fields, and better representation of the turbulent structure in the SGS parameterized fields.

KEYWORDS: Grid Resolution, Parameterizations, Boundary Layer, Mesoscale Modeling, COAMPS

IMPROVING WIND-BASED UPWELLING ESTIMATES OFF THE WEST COASTS OF NORTH AND SOUTH

Mark H. Pickett-Lieutenant Commander, National Oceanic and Atmospheric Administration
B.S., West Virginia University, 1983
M.S., University of Miami, 1991
Doctor of Philosophy in Physical Oceanography-December 2003
Advisors: Franklin B. Schwing, NOAA/PFEL
Leslie K. Rosenfeld, Department of Oceanography
Jeffery D. Paduan, Department of Oceanography
Carlyle H. Wash, Department of Meteorology

In this thesis, coastal upwelling was estimated off the North and South American west coasts using pressure derived winds, model derived winds from the U.S. Navy's global atmospheric model, and QuikSCAT satellite measured winds. Satellite measured winds, verified with U.S. west coast buoys, were shown to be accurate in the near-shore environment. Upwelling estimates derived from pressure derived winds using the Pacific Fisheries Environmental Laboratory technique were compared to those derived from both satellite measured winds and model derived winds. These comparisons showed that upwelling estimates based on the Navy's global model winds were accurate in more regions than those based on pressure-derived winds. A fine-scale upwelling investigation using the Navy's high-resolution atmospheric model revealed narrow near-shore bands of strong wind-stress and wind-stress-curl missed in the above upwelling estimates. Improvements in the depiction of coastal upwelling will require wind data and upwelling estimates with at least a 10 km resolution.

KEYWORDS: Upwelling, California Current, Peru/Chile Current, QuikSCAT, Wind-Stress Curl, Upwelling Index, Ekman Transport, Ekman Pumping

DOCTOR OF PHILOSOPHY

A METRIC MODEL FOR INTRANET PORTAL BUSINESS REQUIREMENTS

Grant A. Jacoby-Lieutenant Colonel, United States Army

B.S., United States Military Academy, 1985

M.B.A., Boston University, 1992

M.S., University of Colorado-Boulder, 1994

M.S., University of Colorado-Boulder, 1994

Doctor of Philosophy in Software Engineering-December 2003

Advisor: Luqi, Department of Computer Science

Second Reader: Valdis Berzins, Department of Computer Science

This research provides the first theoretical model -- the *Intranet Efficiency and Effectiveness Model* (IEEM) -- for the *Family of Measures* approach to measure Web activity as well as a holistic framework and multi-disciplinary quality paradigm approach not previously derived in viewing and measuring *intranet* contributions in the context of a corporation's overall critical business requirements. This is accomplished by applying a balanced baseline set of metrics and conversion ratios linked to business processes as they relate to knowledge workers, IT managers, and business decision makers seeking to increase value. It also outlines who should conduct these measurements and how in the form of a business intelligence team and provides a means in which to calculate *Return on Intranet Metrics Investment* (ROIMI) with a common unit of analysis for both aggregate and sub-corporate levels through forms of the *Knowledge Value Added* (KVA) and *Activity Based Costing* (ABC) methodologies.

KEYWORDS: Intranet, Portal, Metrics, Quality, Business Intelligence, Knowledge Value Added, Activity Based Costing, Return on Investment, Family of Measures, Software Engineering

ASTRONAUTICAL ENGINEER

FLEXIBLE MULTIBODY DYNAMICS AND CONTROL OF THE BIFOCAL RELAY MIRROR

Brian M. Moore-Captain, United States Army

B.S., Purdue University, 1993

M.S.A., Central Michigan University, 2001

Astronautical Engineer-December 2003

Master of Science in Astronautical Engineering-December 2003

Advisor: Brij N. Agrawal, Department of Mechanical and Astronautical Engineering

Second Reader: Marcello Romano, National Research Council Research Associate

In recent years, spacecraft have become increasingly flexible. The design requirements for the Bifocal Relay Mirror spacecraft include controlling jitter at the nanoradian level. Typically, tight pointing requirements require high structural stiffness, at the cost of increasing the on-orbit mass. To accomplish this, while minimizing the mass of the spacecraft, the structure will have some inherent flexibility. These flexible modes will interact with the pointing control, hence affecting the payload performance. The compensator design conducted in this thesis achieves order of magnitude improvements in controlling the rate error, hence jitter. This thesis starts with a rigid body dynamic model, and develops a flexible body dynamic model. Once the model is developed, the structure-controls interaction is discussed. Finally, compensators are applied to the rigid body controller to mitigate the performance losses present in the flexible body system. Through classical second-order compensators, the angular rate error was decreased by a factor of ten. Nonminimum phase notch filters and phase lag filters were used. Ultimately, the phase lag filters provided the best performance.

KEYWORDS: Controls, Flexible, Flexibility, Structure, Compensator, Filter, Bifocal Relay Mirror, Modal, Modes, Laser, Satellite, Spacecraft, MATLAB, SIMULINK, Attitude

**MASTER
OF
BUSINESS ADMINISTRATION**

MASTER OF BUSINESS ADMINISTRATION

A LITERATURE REVIEW OF EMPOWERMENT WITH A SUGGESTED EMPOWERMENT MODEL FOR BAHRAIN DEFENSE FORCE

Adnan M. Al Sada-Major, Bahrain Defense Force

Master of Business Administration-December 2003

Advisors: Alice Crawford, Graduate School of Business and Public Policy

Bill Gates, Graduate School of Business and Public Policy

In recent years, the topic of empowerment has been given a great deal of attention due to its influence on organizational effectiveness and innovation. This project will review the literature of the empowerment concept including the roots, definitions, notions, elements, and different models that have been developed by management experts.

Based on the literature review, an empowerment model will be proposed for Bahrain Defense Force (BDF). The model will be based on three dimensions: empowering management practices, empowered individual, and empowering working environment.

KEYWORDS: Empowerment, Employees' Empowerment, Empowerment Model

ANALYSIS OF THE CONTINGENCY CONTRACTING SUPPORT PLAN WITHIN THE JOINT PLANNING PROCESS FRAMEWORK

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The Joint Planning Process (JPP), by doctrine, does not include Contingency Contracting Support Plans (CCSPs) as an annex within Joint Operation Plans (OPLANs) or Joint Logistics Plans (LOGPLANS), thereby limiting Combatant Commander (COCOM) flexibility and responsiveness. Current OPLANs at the Joint-level *generally* discuss how forces will be contractually supported in-theater, but are not *specific* enough within the framework of the Joint Planning Process (JPP). This project analyzed the effectiveness of the Joint OPLANs with respect to contracting relationships in a contingency contracting environment. Conclusions and recommendations for the formal, detailed inclusion of CCSPs within the JPP include: the CCSP should be formally detailed in the Deliberate Planning Process (DPP) and Crisis Action Planning (CAP) Process from the National-level to the small unit-level; the formal, detailed inclusion of CCSPs within the planning process at the Joint-level would be a force-multiplier in terms of proactive vice reactive planning for contingencies within the Joint arena; and utilizing the experience of Contracting Officers (COs) within Joint planning cells would result in the ability to leverage time and provide the COCOM flexibility and responsiveness early on in the planning process within the framework of the CCSP.

KEYWORDS: Combatant Commander, Contingency, Contingency Plan, Contingency Contracting, Contingency Contracting Support Plan, Contracting, Crisis Action Planning, Deliberate Planning Process, Joint Operation Planning Execution System, Joint Planning and Execution Community, Joint Strategic Capabilities Plan, Logistics Capability Contract, Logistics Plan, National Command Authority, Operations Order, Operations Plan, Time-Phased Force Deployment Density List

MASTER OF BUSINESS ADMINISTRATION

AN ANALYSIS ON THE APPLICABILITY OF A PRIVATE FINANCE INITIATIVE TO MEET USMC ENGINEER EQUIPMENT NEEDS

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The purpose of this report is to investigate the feasibility of supporting United States Marine Corps Engineering Equipment operation and maintenance requirements through a Private Finance Initiative (PFI). The reason for this comparison is that the Marine Corps has realized that the current operating structure is not cost effective. This report evaluates what a PFI is and how it is structured. Information is provided by the United Kingdom Ministry of Defense (UK MOD), which is considering a PFI solution to its engineer equipment needs. The UK Ministry of Defense has used PFI's extensively over the past decade to meet a variety of service support requirements. Next, the report will analyze the mission, requirements, operations, structure, and emerging concepts of the USMC engineer community to determine what functions the Marine Corps does well and which are core to its business. Based on this information, the report will propose a PFI structure that would meet all USMC engineer equipment operation and maintenance needs. The draft PFI attempts to address all of the particular requirements that the Marine Corps would need to consider in this type of contractual relationship.

KEYWORDS: Public Private Partnership, Private Finance Initiative, Engineer Equipment, Contract Management, Contract Risk, Life Cycle Management

ANALYSIS OF CHURN AND EXCESS MATERIAL AT THE PEARL HARBOR NAVAL SHIPYARD

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This professional report is for a Naval Shipyard. The amount of material ordered after beginning an availability (churn) and the amount of material ordered but not used (excess) are key performance indicators. Pearl Harbor Naval Shipyard's metrics indicate that an average of 50% of material ordered during an availability is ordered after the start of the availability and that 15% of material is excess. The NAVSEA goal for both metrics is 5%. The causes of high rates of material churn and excess at Pearl Harbor Naval Shipyard are investigated and recommendations for reducing them are provided.

KEYWORDS: PHNSY Churn and Excess Material, Pearl Harbor Naval Shipyard Churn and Excess Material

MASTER OF BUSINESS ADMINISTRATION

COST BENEFIT ANALYSIS OF THE DEPARTMENT OF THE NAVY'S F-5 TIGER II CONTRACT

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This project consists of a Cost Benefit Analysis (CBA) of the costs, issues, and effects associated with replacing the F-5E/F Tiger II aircraft with F/A-18A/B. The three alternatives analyzed are: (1) continued operation of the F-5E/F, (2) replacement of the F-5 with F/A-18A/B by 2008, and (3) installation of 4th generation pulse-doppler radar in the F-5E/F by 2008. The objective was to compare the three alternatives, choosing the alternative which provides the greatest net benefit and most efficient use of resources. The analysis involved data collection of operational costs per flight hour, total cost over the life of the program, and contractor supported maintenance. Data for this research project were gathered from the actual maintenance contracts for both the F-5E/F Tiger and F/A-18A/B aircraft at Fallon, Nevada, Naval Aviation Systems Command, and OFC-20. The results suggest that NAVAIR should continue to use the F-5E/F Tiger II aircraft for the VFC-13 adversary training mission through 2014.

KEYWORDS: Cost Benefit Analysis, Flying Hour Program, Contract Closeout, Termination for Convenience, Contract Solicitation

MARINE CORPS CONTINGENCY CONTRACTING-MCI

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Contingency contracting is the process where vital supplies and services needed to maintain deployed forces are obtained on behalf of the United States Government. These actions are used for emergencies, such as disaster relief from hurricanes or from terrorist activities that occur within the United States, or for actions that occur outside of the United States in order to support the deployed units. Due to the current trend in the DoD to contract out more products and services on the battlefield, an increase demand has been placed on contingency contract personnel.

The purpose of this MBA project was to develop and publish a Contingency Contracting MCI to assist the Marine Corps in training its contract personnel in preparation for deployment to a contingency operation. Currently, there is no requirement for the contracting specialist to attend a formal school prior to supporting a contingency operation. Furthermore, there are limited spaces for Marines to attend CON 234. The Contingency Contracting MCI will aid the contracting personnel with the training needed to be successful in a contingency environment and efficiently and effectively support Marine Corps units abroad. This project was sponsored by Headquarters Marine Corps, Installation and Logistics, Logistics Branch, in conjunction with the Marine Corps Institute (MCI). The MBA report has identified several problems in the current ability of the Marine Corps to train contracting personnel in contingency contracting and provides recommendations for further study. A draft Contingency Contracting MCI is included in the report, however, it is still undergoing validation through MCI.

MASTER OF BUSINESS ADMINISTRATION

KEYWORDS: Contingency Contracting, MCI, Contingency Environment, Contingency Operations, Contracting Specialist, Contingency Contracting Officer, Contracting

METRIC DEVELOPMENT DURING THE REORGANIZATION OF THE SUPPLY CHAIN MANAGEMENT CENTER

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This MBA Project documents a case study of an ongoing reorganization effort at the Supply Chain Management Center (SCMC), Marine Corps Logistics Command (MARCORLOGCOM), and their use of the Supply Chain Operations Reference (SCOR) Model and the Balanced Scorecard (BSC) to develop performance metrics based on sound processes. The primary focus was on the SCMC. In addition, the Source Management Department, one of SCMC's subordinate units, was a secondary focus. Background information about SCOR and BSC were reviewed, as well as what has been implemented thus far with SCMC. Finally, considerations regarding the assessment and management of suppliers were offered as recommendations.

KEYWORDS: Supply Chain Management Center, SCMC, Supply Chain Operations Reference Model, SCOR, Balanced Scorecard, BSC

ESTABLISHING THE ROLE, FUNCTIONS AND IMPORTANCE OF PROGRAM MANAGERS AND PROGRAM MANAGEMENT TEAMS IN THE AFP MODERNIZATION PROGRAM ACQUISITION PROCESS: A COMPARATIVE ANALYSIS WITH U.S. DOD SYSTEM

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This research describes the Acquisition Process of the Armed Forces of the Philippines (AFP) Modernization Program, particularly the role, functions, and importance of Program Managers (PM) and Program Management Teams (PMT) in the overall process. The Modernization Program, including acquisition processes for new systems, is a new experience for the AFP. Apparently, the organization intends to optimize the acquisition process for new systems by ensuring an effective and accountable organization structure that would sustain AFP modernization efforts and capabilities.

Presently, PMs and PMTs are temporary in the organizational structure and have no concretely delineated role in the acquisition process. Their function and responsibilities are limited to the AFP Major Service requirement generation process.

Likewise, this research will introduce the U.S. DoD acquisition system and illustrate the DoD PMs' and Integrated Project Team's (IPT) roles and functions in defense programs. The paper will show the importance of the PM and IPTs to the overall life cycle of any system. By comparative analysis, the research will reveal limitations in the AFP approach. The U.S. acquisition model, relative to PMs and PMTs, will be useful for improving the AFP process. After all, the U.S. has proven itself relatively successful in acquisition projects.

KEYWORDS: Program Managers, PM, Program Management Teams, PMT, IPT

MASTER OF BUSINESS ADMINISTRATION

AN ANALYSIS OF SPENDING PATTERNS ASSOCIATED WITH THE PHALANX CLOSE-IN WEAPON SYSTEM (CIWS) PROGRAM

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In light of the current world climate, U.S. military force protection has become an increasing concern. The bombing of the *USS COLE* and terrorist actions on the World Trade Center buildings show a vulnerability to attack both at home and abroad. In response to this threat, the PHALANX has become an attractive system for re-evaluation as a deterrent to hostile airborne threats to U.S. Navy surface ships.

Because it is a mature system, data exist related to past spending patterns and the resultant outputs of that spending. This project analyzes those spending patterns and identifies potential areas of investigation for cost savings.

KEYWORDS: PHALANX, Spending Patterns, ROI, Cost Savings

EXAMINATION OF THE OPEN MARKET CORRIDOR

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Present procurement practices for the purchase of commercial, commercial-off-the-shelf, and non-developmental products and services can take anywhere from thirty days to years to procure and deliver to the end user. Federal Government contracting offices spend costly amounts of time advertising the actions and preparing formal solicitation documents for each purchase order generated by the end-user. This translates to high administrative costs, high prices, and, at times, marginal performance. In an effort to ease the administrative burden on the contracting system throughout the DoD by capitalizing on current technologies, a new system was recently developed by faculty and students at the Naval Postgraduate School. This new program is currently under testing by a prime contractor under the auspices of the Department of the Interior. The new on-line contracting/procurement program, known as the Open Market Corridor, will allow Federal, State, and local Government users to purchase supplies and services on-line through the use of electronic catalogs and embedded contract templates accessible via the Internet. This thesis project will review various aspects of the new program, evaluate current efficiencies and recommend modifications in an effort to improve the current procurement and logistics process.

KEYWORDS: Procurement, E-Commerce, E-Procurement, Contingency Contracting, Defense Transportation System, Government Wide Purchase Card, Wireless Communication, IT Security

MASTER OF BUSINESS ADMINISTRATION

PROJECT MANAGEMENT IN MAJOR SYSTEMS ACQUISITION FOR THE POLISH ARMED FORCES

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This project investigates the potential role of project management policy in major systems acquisition for the Polish Armed Forces (PAF). It includes: a short overview of program management in the United States Department of Defense (DoD); an analysis of present procedures in the PAF; a cost and benefit discussion of implementing the policy in Poland; and finally, a discussion of possible solutions and implementation plans.

The PAF have undergone major transformation since the fall of the Berlin wall and the dissolution of the Warsaw Pact. Serious reduction of the PAF has been accompanied by technical restructuring and modernization of several major weapon systems, which must meet new, high NATO standards. Successful and effective managing of the acquisition process seems to be crucial for the new shape of the PAF.

However, no centralized management across all phases of the acquisition process exists in Poland at the moment. Different military and civilian authorities dominate different phases of the acquisition process. There is an urgent need to implement project management policy in order to consolidate the efforts of all the branches and to ensure a successful transformation of the PAF.

KEYWORDS: Project Management in the Polish Armed Forces, Acquisition in Poland, Managing Acquisition Projects, PM Structures in the PAF, Costs and Benefits of PM Policy in Poland

MARINE CORPS UNIT-LEVEL INTERNAL MANAGEMENT CONTROLS FOR THE GOVERNMENT-WIDE COMMERCIAL PURCHASE CARD

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In this thesis, recommendations are offered to improve current internal management controls for the Government-Wide Commercial Purchase Card (GCPC) program. Despite the existence of mandated internal management controls, the program has been fraught with fraud, misuse, and abuse since its implementation. The 2002 General Accounting Office testimony on the Navy GCPC program noted the continued existence of significant internal control weaknesses, despite a number of improvements made to the program over several years. Using the "fraud triangle" as its philosophical construct, this thesis develops practical methods by which to lessen the ability of those involved with administration of a GCPC program to rationalize improper and illegal actions. Its specific recommendations are: to convert the GCPC cards from individually named credit cards to unit cards with personalized numbers; to change the appearance of the cards; to control the number of cards within each unit by authorizing level five APCs to define and implement "best practice" controls; and to provide electronic receipts of all cardholder transactions daily to Approving Officials and Agency Program Coordinators.

KEYWORDS: Internal Management Controls, Internal Controls, Government-Wide Commercial Purchase Card, Purchase Card

MASTER OF BUSINESS ADMINISTRATION

INFORMATION TECHNOLOGY PORTFOLIO MANAGEMENT AND THE REAL OPTIONS METHOD (ROM): MANAGING THE RISKS OF IT INVESTMENTS IN THE DEPARTMENT OF THE NAVY (DON)

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The FY 2003 Federal Budget contains provisions for over \$52 billion in IT investments. The Navy portion of those funds is over \$5 billion. Rapid change and increasing uncertainty in the technology field has resulted in a high degree of financial risk associated with IT capital investment decisions. The Federal Chief Information Officer (CIO) Council has endorsed IT Portfolio Management (ITPM) as an approach for making IT investment decisions. This research draws upon ITPM implementation strategies currently employed by the DoN and provides recommendations for managing the inherent risk in IT investments, specifically the application of the Real Options Method (ROM). ITPM provides a thoughtful framework for managing the capital investment process, but still depends primarily on traditional methods such as EVA, IRR, and NPV for evaluating IT investment alternatives. This study uses the Naval Supply Systems Command (NAVSUP) Automatic Identification Technology (AIT) program to illustrate how ROM can be utilized to supplement these traditional valuation methods and aid in managing investment risks. IT capital investments are inherently linked to organization strategy and the uncertainties that define the future. This study demonstrates how ROM can allow managers to capitalize on the uncertainties of IT investment decisions to implement organization strategy.

KEYWORDS: Information Technology Management, Information Technology Investment, Real Options Method

UPDATE OF NAVY CONTRACT WRITING GUIDE

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The purpose of this MBA project is to provide a comprehensive update of the Navy Contract Writing Guide. The project was conducted with the sponsorship and assistance of the Office of the Assistant Secretary of the Navy for Research, Development, and Acquisition. The now out-of-date guide was originally written in 1996 in an effort to reduce problem disbursements as related to contract wording and organization. Extensive research, incorporating interviews, websites, periodicals, and texts, was employed to make the guide current. It has been reorganized to address issues and solutions in the same order in which the forms used by contracting officers and administrators have them listed. New issues have been raised since the original writing of this guide and are now incorporated with their recommended solutions. Individuals new to Naval contracting or those who have decades of experience will find the information provided useful to the efficient and effective writing and administration of government contracts.

KEYWORDS: Contracting, DFAS, Navy Contract Writing Guide, Problem Disbursements, Contract Administration

MASTER OF BUSINESS ADMINISTRATION

ORGANIZATIONAL ASSESSMENT OF SHELTER OUTREACH PLUS

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This report is an organizational analysis of Shelter Outreach Plus (SOP), a non-profit agency in Monterey County providing homeless support and shelter, domestic violence victim support, and women and men transitional support services. Semi-structured interviews were conducted with four Board members and 11 staff members to generate an organizational diagnosis using systems theory as a foundation for improvements. A strategic planning session was arranged and facilitated, and Board members and key personnel generated strategic goals. There is widespread passion and commitment to the mission, including long-term delivery of multiple and unique services which positively impact the county. There is little interaction among the five program offices, and trust and leadership issues exist between staff and executive leadership. SOP faces fiscal challenges brought on by statewide cutbacks and lack of county-wide visibility. Information technology improvements are ongoing and needed, and a more decentralized decision-making structure is recommended both for operational efficiency and needed employee motivation.

KEYWORDS: Systems Model, External Environment, System Direction, Structure, Technology, Process

SUPPLY CHAIN ANALYSIS OF GABILAN MANUFACTURING INC.

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The purpose of this MBA Project was to investigate and provide alternative supply chain management strategies to assist Gabilan Manufacturing Inc. in reducing supply chain costs. This project was conducted with the sponsorship and assistance of Gabilan Manufacturing Inc. There were two primary goals of this project. The first was to identify and document the impact of forecasting errors in an environment where customer forecasts are available to the vendor. The second was to investigate the costs associated with relocating cutting operations, as well as the procurement impact of a new cutting machine. Both of these goals relate directly to the overall effort to reduce supply chain costs without a loss of service level to Gabilan's customer.

KEYWORDS: Supply Chain, Information Sharing, Forecasting Error, Capacity Utilization, Relocation Costs, Demand Forecasting, Tube Cutting Operation Analysis, Capacity, Resource Allocation, Utilization of Machinery, Gabilan Manufacturing, Inc.

MASTER OF BUSINESS ADMINISTRATION

EFFECT OF OPTEMPO ON SHIP OPERATIONAL COSTS

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The purpose of this study was to determine the relationship between operations tempo (OPTEMPO) and operational costs. This study was performed at the request and with the support of OPNAV N82, the Office of Budget (FMB). The goal of this project was to increase the flexibility, scalability, and justifiability of the analytical model used by FMB to budget for ship operations. This study provides a detailed description of the model, including modifications made by the only other study of the FMB budgeting model. The core of the analysis centered around a regression of OPTEMPO and expenditure data. From the resultant regression equations, incremental costs of ship operations could be distilled. However, during the preliminary data validation, significant correlations were found only within the Arleigh Burke Destroyer Class of ship. These correlations were likely spurious and due to the large number of new commissionings within that class over the period of study. The lack of ability to define any relationship between OPTEMPO and expenditures is possibly due to complete expenditure of fund allocations regardless of actual costs.

KEYWORDS: Budget Allocation, Correlation, Cost Analysis, Cost Estimates, Expenditures, Forecasting, Navy, Naval Vessels, Operating and Maintenance Costs

DOD SUPPLY CHAIN IMPLICATIONS OF RADIO FREQUENCY IDENTIFICATION (RFID) USE WITHIN AIR MOBILITY COMMAND (AMC)

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The purpose of this MBA project is to identify the existing and potential value of Radio Frequency Identification (RFID) use in the operations of Headquarters Air Mobility Command (HQAMC) and its worldwide network of aerial ports. The project seeks to determine how the applications of RFID within AMC can add value to AMC's operations and the operations of other DoD supply chain members. In doing so, the project describes the technical attributes of DoD's RFID tags and infrastructure, AMC's legacy Automated Information System (AIS), known as Global Air Transportation Execution System (GATES), and AMC's role within its supply chain. The project includes a discussion of potential AMC and DoD supply chain RFID applications and resulting potential value. Ultimately, the project offers a process for creating a robust RFID infrastructure.

KEYWORDS: Supply Chain Management, Radio Frequency Identification, Global Optimization

MASTER OF BUSINESS ADMINISTRATION

REALIGNMENT AND THE PROCESS OF CHANGE AT THE NAVAL POSTGRADUATE SCHOOL

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Few studies have focused on the effects of change within a military graduate institution where military and academic subcultures coexist. This research focused on the 2001 organizational change at the Naval Postgraduate School. The purpose was to identify how change was approached and implemented. The analysis revealed that this change process, implemented across the organization, affected the intensity of subcultural conflict within the organization. In the case of NPS, it was found that an authoritarian military style of change negatively impacted the existing academic subculture. The pressure of a change effort that was not representative of both subcultures served to increase the intensity of conflict between the military and academic subcultures, thus jeopardizing the ability of the two to work together. This study contributes to and amplifies existing theory through the examination of organizational change in a unique military/academic environment. It is important for change agents to understand how these factors are interrelated so that the intensity of cultural conflict can be better managed.

KEYWORDS: Change, Transformation, Organizational Theory, Conflict, Culture, Multi-Cultural, Thematic Analysis, Code Development, Grounded Theory, Modeling

JABEZ RECORDS FORMAL BUSINESS PLAN

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The purpose of this MBA project was to provide a formal business plan for JABEZ Records of Vallejo, California. This project was conducted with the sponsorship and assistance of Cal-Precisions General Contractors, a residential and commercial general construction and contracting company of Vallejo, California. The primary objectives of this project were: to identify and document the specifics of the market for the business; to analyze the company's organizational structure; and to analyze and document JABEZ Records' financial activity. The ultimate goal for the business plan was to provide investors with a formal document that would put into plain words, the structure, creditability, vision, and justifiable financial requirements of JABEZ Records.

KEYWORDS: JABEZ, Record, Music, Gospel, Studio

MASTER OF BUSINESS ADMINISTRATION

A COST BENEFIT ANALYSIS OF SECURITY AT THE NAVAL POSTGRADUATE SCHOOL

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This project was a cost-benefit analysis of security at the Naval Postgraduate School. The objective was to determine if the reduction in the probability of a risk of attack would be worth the costs. The product is a comprehensive cost-benefit analysis of increased security measures at NPS following the September 11th terrorist attacks.

The present value approach was used as a guide to compare the cost of preventative measures against a physical attack and the value of benefits preserved by a deterred attack. Often, cost is simply measured in outlays, while other major cost items, such as the opportunity cost of time and intangible costs, are excluded. This analysis assigned a monetary value to opportunity and intangible costs, in addition to actual dollars spent. Benefits included the replacement cost of buildings and computer hardware. Additionally, the value of life is measured based on marginal values placed on marginal reductions in life span.

The results of this analysis showed that the school is receiving almost negligible benefits for the substantial incurred costs to reduce the risk of attack. This fact is largely due to the near zero risk before and after the post-September 11 security measures were implemented.

KEYWORDS: Cost-Benefit Analysis, Naval Postgraduate School, Base Security

NAVY/MARINE CORPS TACAIR INTEGRATION: IMPACT ON OPERATIONAL AND SUPPORTING ACTIVITIES

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The purpose of this MBA project was to investigate and provide a comprehensive overview regarding the current issues regarding Tactical Aircraft Integration within the Department of the Navy. This project was conducted with the sponsorship and assistance of the Comptroller, Commander Naval Air Forces Pacific. The goal of this project was to identify issues and provide an analysis of the ongoing efforts between the Navy and Marine Corps. Four criteria were set aside for deliverables: (1) produce key documentation, most notably the Memorandum of Understanding and the Memorandum of Agreement; 2) produce any milestones or timetables required for integration; 3) discuss issues regarding funding and resource allocation as applied to the integration process; and 4) provide information on requirements for integrating operational and supporting activities.

This project delineates a brief history of the operational requirements of the F/A-18 and what necessitated changes within the TACAIR community. The topics covered will explain how the plan was developed based on key assumptions and challenges, the implementation of the transformational plan to date, current funding issues, an analysis with recommendations of the transformational process, and an overview of the cultural change that will inevitably come with the transformation.

KEYWORDS: Tactical Aircraft Integration, TACAIR Integration, TAI, Navy/Marine Corps Aviation Integration

MASTER OF BUSINESS ADMINISTRATION

CONTRACTOR LOGISTICS SUPPORT OF THE MEDIUM TACTICAL VEHICLE REPLACEMENT (MTVR) DURING OPERATION IRAQI FREEDOM

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The Medium Tactical Vehicle Replacement (MTVR) is being fielded by the Marine Corps as a replacement for its aging fleet of five-ton cargo trucks. The MTVR program includes the Marine Corps' first use of Contractor Logistics Support (CLS) for a large tactical ground transportation vehicle. MTVRs were employed during the buildup, major combat, and initial occupation phases of Operation Iraqi Freedom (OIF). This MBA project examines the role of CLS in the supply and maintenance support of the MTVR during the aforementioned phases of OIF. Through a literature study of CLS-related materials, examination of CLS contracts between the Marine Corps and Oshkosh Truck Company, interviews with Marine Corps MTVR program management personnel, and interviews with those who maintained and operated MTVRs during OIF, an in-depth study is presented. Analysis is applied to the data gathered to develop recommendations to optimize the use of CLS in support of the MTVR in a combat environment.

KEYWORDS: Contractor Logistics Support, Medium Tactical Truck, MTVR, Operation Iraqi Freedom

THE COSTS AND BENEFITS OF HIGH SPEED VESSELS RELATIVE TO TRADITIONAL C-17 MILITARY AIRLIFT

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Master of Business Administration-December 2003

Thomas Strenge-Lieutenant, United States Navy
Master of Business Administration-December 2003

Advisors: Kevin R. Gue, Graduate School of Business and Public Policy

David R. Henderson, Graduate School of Business and Public Policy

This cost-benefit analysis, conducted on behalf of Military Sealift Command (MSC), compared HSVs against C-17 aircraft. Using financial and operational data garnered from the *WestPac Express* as well as third-party research, the researchers investigated the following questions: Is the HSV a better choice for intra-theater lift than AMC? Should DoD buy or lease? Should the crew be military or civilian? What other theaters require an intra-theater lift platform? How many HSVs does DoD need?

The results indicate that in ranges of up to 1,500 nautical miles, HSVs have a speed advantage over C-17 airlift. One HSV can move a single battalion of Marines, whereas AMC requires seventeen C-17 aircraft, a number rarely available for such a mission. Additionally, during routine FY03 operations, *WestPac Express* incurred costs of \$12 million. This saved \$8.7 million compared to an estimated AMC cost of \$20.7 million. The study also recommends bareboat leasing to take advantage of the increased operational flexibility. In the absence of significant cost differences, civilian manning is superior to military manning due to organizational fit. The study concludes with a recommendation that MSC institutionalize HSV service in the III MEF AOR and expand the service to all other maritime theaters.

KEYWORDS: High Speed Vessel, High Speed Ferries, Cost-Benefit Analysis, WestPac Express

MASTER OF BUSINESS ADMINISTRATION

THE MARINE CORPS FiST: AN INTER-ORGANIZATIONAL ANALYSIS OF THE FIRE SUPPORT SYSTEM AND ITS ENVIRONMENT

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Master of Business Administration-December 2003

Advisors: Nancy Roberts, Graduate School of Business and Public Policy

Cary A. Simon, Graduate School of Business and Public Policy

The focus of the U.S. Marine Corps is the maneuver element, most importantly the infantry. The artillery exists to support the maneuver element as the all-weather, all-capable fire supporter. The basic organization and strategy for Marine artillery has remained the same for over fifty years. The objective of this project is to analyze the interaction of Marine Corps Artillery and Maneuver units to determine the congruence of the inter-organizational linkages to the stated strategy and operational need. The Fire Support Team (FiST) is the team used to coordinate fire support at the lowest tactical level. It consists of members from all of the fire support assets available to the maneuver company, as well as members of the company command element. Research has been conducted to determine the evaluation of the FiST by various stakeholders and the suggestions they have for improvement. Organizational business literature is applied to the FiST concept in order to frame the analysis and give guidance for improvement. Using organizational analysis, recommendations are provided to improve the customer/service (infantry/artillery) relationship. These models will provide some additional insight into the relationship between these two partners.

KEYWORDS: Artillery, Fire Support Coordination, FiST, Fire Support, Inter-Organization

THREATS TO AND ALTERNATIVES FOR FINANCING SOCIAL SECURITY

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Advisors: John E. Mutty, Graduate School of Business and Public Policy

Bill Gates, Graduate School of Business and Public Policy

This project identified the problems with and threats to the Social Security program caused by the rapid increase of an aging population. It compared and contrasted the traditional system with different proposed alternatives. The author recommended three basic options in a priority order for improving economic growth and personal control, while ensuring fairness for future American generations. The three recommended options are: (1) privatization, (2) raise the payroll tax and increase the number of years for calculating benefits, and (3) raise the payroll tax rate.

KEYWORDS: Social Security, Privatization, Personal Accounts, Reform, Alternatives

IMPLEMENTING TRANSFORMATION: AN ANALYSIS OF MARINE DIRECT AIR SUPPORT REQUIREMENTS

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Master of Business Administration-December 2003

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CDR Philip Candreva, USN, Graduate School of Business and Public Policy

The purpose of this MBA project was to focus on the Marine Direct Air Support Center and the information systems the Marine Corps is fielding to it as part of the Department of Defense's Transformation. As the nexus between air support and the ground combat element, the DASC executes and integrates the current day's Air Tasking Order with the ground element's fires. Interview responses from participants in Operation Iraqi Freedom identified difficulties the DASC encountered in implementing this emerging technology. This project analyzed the strategic alignment of the DASC by identifying any gaps in the links between its business strategy, organizational infrastructure and processes, IT strategy, and information systems infrastructure and processes. This analysis was achieved by first determining how the current transformation effort was perceived by members of the DASC community, analyzing how

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transformation technology was implemented in Operation Iraqi Freedom from a Systems Analysis perspective, and developing an operating definition of what a transformed DASC will be like. These perspectives were then applied to the Strategic Alignment Model (SAM), developed by Henderson and Venkatraman, to help clarify the fit between the current state of the DASC and where it needs to be in terms of organization and IT to meet the requirements of Transformation.

KEYWORDS: Strategic Alignment, Information Technology, Military Transformation, Systems Analysis, DASC, MACCS, TBMCS, AFATDS

RETURN ON CAPITAL EMPLOYED AT NAVAL DENTAL CENTER GULF COAST

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Master of Business Administration-December 2003

Marek Flis-First Lieutenant, Polish Army

Master of Business Administration-December 2003

Advisors: Joseph G. San Miguel, Graduate School of Business and Public Policy

Donald E. Summers, Graduate School of Business and Public Policy

The purpose of this MBA project is to provide a Return on Capital Employed model for Naval Dental Center Gulf Coast resource managers. The model will enable the resource managers to evaluate financial and personnel assets appropriate for each dental clinic and to move assets as deemed necessary based on those results. This project was conducted with the sponsorship and assistance of Naval Dental Center Gulf Coast.

KEYWORDS: Return on Capital Employed, Resource Utilization

RESIDENTIAL COMMUNITIES INITIATIVE: A CASE STUDY

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Master of Business Administration-December 2003

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Master of Business Administration-December 2003

Advisor: Jeffrey R. Cuskey, Graduate School of Business and Public Policy

Second Reader: Cary A. Simon, Graduate School of Business and Public Policy

The purpose of this MBA report was to investigate and provide a comprehensive overview of the Residential Communities Initiative within the United States Army. This project was conducted with the assistance of the Monterey Bay Housing Program Executive Office and the Program Manager for the Residential Communities Initiative. The goal of this project was to analyze this initiative and compare the way the Army is privatizing housing with the initiatives that the United States Navy and United States Air Force are utilizing. The Monterey Bay was used as a case study to investigate how Residential Communities Initiative was instituted at an installation. The case study was analyzed from a business and contracting standpoint.

KEYWORDS: Military Housing, Privatization, Residential Communities Initiative, Military Housing Privatization Initiative

MASTER OF BUSINESS ADMINISTRATION

COST AVOIDANCE ANALYSIS, SAFE SCHOOLS ENVIRONMENT PROGRAM, CITY OF SALINAS, CALIFORNIA

Michael J. Zerbo-Lieutenant Commander, United States Navy

Master of Business Administration-December 2003

Scott A. Gustin-Lieutenant, United States Navy

Master of Business Administration-December 2003

Eri W. Brinkerhoff-Captain, United States Marine Corps

Master of Business Administration-December 2003

Ernest Govea-Captain, United States Marine Corps

Master of Business Administration-December 2003

Advisors: Kenneth J. Euske, Graduate School of Business and Public Policy

Mary A. Malina, Graduate School of Business and Public Policy

There are six support programs provided to the Salinas, California, K-12 School System under the Safe Schools/Healthy Students Initiative. The goal of this project is to develop quantitative estimates of the cost and the corresponding cost avoidance associated with element one – Safe Schools Environment. The Safe Schools Environment element consisted of two programs: Probation Officer and School Resource Officer. A cost avoidance analysis was conducted in order to assist the Safe Schools/Healthy Student Director in evaluation of the programs' effectiveness and provide a foundation to pursue further federal funding. This project revealed that these two programs were cost effective and provided a positive impact to the Salinas community. Moreover, this project provided data that these two programs provided a significant return on investment for the taxpayer and warrant continued federal funding.

KEYWORDS: Cost Avoidance, School Resource Officer, Student Attendance Enhancement Program, Safe Schools/Healthy Students Initiative

MASTER OF SCIENCE

Aeronautical Engineering
Applied Physics
Applied Science
Astronautical Engineering
Combat Systems Technology
Computer Science
Contract Management
Defense Analysis
Electrical Engineering
Engineering Acoustics
Engineering Science
Information Systems and Operations
Information Technology Management
Leadership and Human Resource Development
Management
Mechanical Engineering
Meteorology and Physical Oceanography
Modeling, Virtual Environments, and Simulation
Operations Research
Physical Oceanography
Product Development
Program Management
Software Engineering
Systems Engineering
Systems Technology

MASTER OF SCIENCE IN AERONAUTICAL ENGINEERING

DESIGN OF A LIFT FAN ENGINE FOR A HEAVY LIFT AIRCRAFT

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Master of Science in Aeronautical Engineering-December 2003

Advisor: Raymond P. Shreeve, Department of Mechanical and Astronautical Engineering

Second Reader: E. Roberts Wood, Department of Mechanical and Astronautical Engineering

Recent conflicts have highlighted the difficulties in using aircraft to supply troops in modern warfare. Lift fan technology is seen as one way in which to improve future supply aircraft to meet the needs of the military. A previous study designed a heavy lift aircraft with lift fan engines that used future engine technology. This present study modified the design by using current engine technology for the lift fan engines. The modification is important because a design that uses current technology is more likely to be brought into service in the near future.

This thesis documents the process required to use current technology in a lift fan engine for a heavy lift aircraft. The process uses current software and focuses on the design of the following components: the powerplant, the transmission shafts, and the lift fan. The result is a propulsion system which allows a 185,000 lb aircraft to takeoff vertically, as well as cruise at speeds greater than Mach=0.6.

KEYWORDS: Heavy Lift Aircraft, Lift Fan Engine, Lift Fan

IMPROVEMENT OF THE PERFORMANCE OF A TURBO-RAMJET ENGINE FOR UNMANNED AERIAL VEHICLES AND MISSILE APPLICATIONS

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B.S., Hellenic Air Force Academy, 1993

B.S., National Technical University of Athens, 1999

Master of Science in Applied Physics-December 2003

Master of Science in Aeronautical Engineering-December 2003

Advisor: Garth V. Hobson, Department of Mechanical and Astronautical Engineering

Second Reader: Kai E. Woehler, Emeritus Professor

An existing turbo-ramjet engine was modified in order to increase the produced thrust and sustain combustion at increased freejet Mach numbers. The engine's afterburner fuel system was redesigned to improve the vaporization and atomization of the fuel. The engine performed satisfactorily at speeds up to Mach 0.3, producing 100% more thrust over the baseline turbojet. The data acquisition system of the turbo-ramjet engine's performance measurement in a freejet facility was also updated. Various computational fluid dynamics models of the flow through the turbo-ramjet engine were developed to visualize the flow and to predict the engine performance at different Mach numbers.

KEYWORDS: Turbo-Ramjet, Afterburner, UAV Propulsion, Missile Propulsion, Computational Fluid Dynamics, OVERFLOW, Freejet, Small-Scale Engines

AERONAUTICAL ENGINEERING

INVESTIGATION OF INCREASED FORWARD FLIGHT VELOCITIES OF HELICOPTERS USING SECOND HARMONIC CONTROL AND REVERSE VELOCITY ROTOR CONCEPT

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Master of Science in Aeronautical Engineering-December 2003

Advisor: E. Roberts Wood, Air Force Institute of Technology

Second Reader: Raymond P. Shreeve, Department of Mechanical and Astronautical Engineering

This thesis describes the behavior of a rotorcraft equipped with Higher Harmonic Stall Control (HHSC) and a Reverse Velocity Rotor (RVR). Current rotorcraft are limited in forward flight speed by retreating blade stall and compressibility effects on the advancing blade. Stall occurs as the blade encounters increasingly severe reverse flow. HHSC enables conventional rotor systems to fly on the forward and aft sections of the rotor disk, greatly reducing reliance on the mixed flow regions defined by the advancing and retreating blades. Employment of the RVR allows lift generation while the rotor is experiencing reverse flow. A similar type of two per revolution (2/rev) input can be tailored to deliver maximum benefit to RVR equipped rotorcraft. Modification of the Joint Army Navy Rotorcraft Analysis and Design (JANRAD) computer program allows 2/rev cyclic input, use of the RVR, and analysis using high fidelity graphical output to examine angle of attack, coefficient of lift, and air load. Computational results show performance gains in conventional helicopters and high speed flight potential for RVR equipped aircraft. The RVR is applied to the Joint Heavy Vertical Lift (JVHL) aircraft conceptual design for preliminary analysis. This conceptual design can be used as an indicator of the performance of a high speed RVR equipped aircraft.

KEYWORDS: Higher Harmonic Stall Control, Reverse Velocity Rotors, Heavy Lift Aircraft

MASTER OF SCIENCE IN APPLIED PHYSICS

THE SHIPBOARD EMPLOYMENT OF A FREE ELECTRON LASER WEAPON SYSTEM

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Master of Science in Applied Physics-December 2003

Advisor: William B. Colson, Department of Physics

Second Reader: Robert L. Armstead, Department of Physics

A megawatt (MW) class Free Electron Laser (FEL) shows promise as a new weapon for anti-ship cruise missile defense. An FEL weapon system delivers energy at the speed of light at controllable energy levels, giving the war fighter new engagement options. Considerations for this weapon system include employment, design, and stability. In order to reach a MW class laser, system parameters must be optimized and the high power optical beam must be appropriately managed.

In a high power FEL, the optical beam could heat and ultimately damage the optical cavity mirrors. One proposed solution is a short Rayleigh length design, which lowers the intensity on the mirrors, but increases sensitivity to vibrations. This thesis shows that a short Rayleigh length FEL will remain stable using current technology and can be designed to achieve a MW of power. Scenarios are then presented to explore some of the engagement options associated with this weapon system.

KEYWORDS: Free Electron Laser, Short Rayleigh Length, Directed Energy, Mirror Stability

WIRELESS IR IMAGE TRANSFER SYSTEM FOR AUTONOMOUS VEHICLE

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Master of Science in Applied Physics-December 2003

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Richard M. Harkins, Department of Physics

A wireless IR image transfer mechanism was developed and tested for eventual employment on the NPS autonomous ground vehicle. Tests were conducted inside a building as a rough simulation of an urban environment. Two common ISM frequency bands were explored. Experiment results proved that the 915 MHz band was best suited for this effort. Data revealed that minimal signal loss occurs at Line of Site out to several hundred meters. Signal loss through obstructions (cement, wood, and metal) proved significant, on the order of 10 -15 dB per obstruction. But the image transfer was successful through multiple obstructions at a range of 400 meters. Further work includes integration into the autonomous vehicle and testing of the performance.

KEYWORDS: IR Image Transfer, Antenna Polarization, Serial Communication, Wireless Communication, Received Signal Strength

APPLIED PHYSICS

HIGH POWER OPTICAL CAVITY DESIGN AND CONCEPT OF OPERATIONS FOR A SHIPBOARD FREE ELECTRON LASER WEAPON SYSTEM

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Master of Science in Applied Physics-December 2003

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Second Reader: Robert L. Armstead, Department of Physics

A megawatt (MW) class Free Electron Laser (FEL) as a point defense weapon system may lead to a revolution in anti-ship missile defense. Deep magazine, low cost, proportional engagement capability, and speed of light energy delivery provide the FEL with unmatched advantages over kinetic energy weapon systems. Before a FEL is made fleet deployable, stability, system parameter optimization, and operational utility all must be taken into account.

A short Rayleigh length FEL design is being considered in order to reduce system size and mitigate resonator mirror damage. A short Rayleigh length though, can lead to vibrational sensitivities which must be studied. This thesis demonstrates that utilizing currently available technology and properly defined parameters, a short Rayleigh length FEL should be able to achieve a MW of power.

This thesis will also establish the viability of the FEL as a fleet deployable point defense weapon system through the development of a Concept of Operations (CONOPS) which draws from current naval warfare doctrine.

KEYWORDS: Free Electron Laser, Point Defense Weapon System, Shipboard Free Electron Laser System

TUNABLE BANDWIDTH QUANTUM WELL INFRARED PHOTO DETECTOR (TB-QWIP)

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Master of Science in Applied Physics-December 2003

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James H. Luscombe, Department of Physics

In this thesis, a tunable bandwidth quantum well photo-detector (TB-QWIP) is fabricated and experimentally characterized. The designed detector is based on the Stark effect with two quantum step wells arranged opposite to each other to simultaneously achieve both blue and red shift of the absorption peak for either direction of the bias. The characterization of the TB-QWIP is based on absorption measurement with Fourier Transform Infra Red (FTIR) spectroscopy, current versus applied voltage (I-V) measurement with a semiconductor parameter analyzer, and photo current spectroscopy. The measured IR absorption peaks found at room temperature $8.8\ \mu\text{m}$ and $10.0\ \mu\text{m}$ are in good agreement with designed values. The dark current of the test detector was found to be $10^{-9}\ \text{A}$ and a background photocurrent was found to be $700 \times 10^{-9}\ \text{A}$ at $-4\ \text{V}$ bias at $10\ \text{K}$. The background-limited performance of the device was found to be at $60\ \text{K}$. The peak responsivity of the detector was $0.39\ \text{A/W}$ at $8.2\ \mu\text{m}$. The maximum normalized detectivity under background limited conditions D^*_{BLIP} , was calculated to be $3.5 \times 10^{11}\ \text{cm}\sqrt{\text{Hz}}/\text{W}$. The bandwidth of the detector tuned with bias from $1.8\ \mu\text{m}$ at $-1\ \text{V}$ to $2.7\ \mu\text{m}$ at $-4\ \text{V}$, which amounts to 50% higher bandwidth than the original. Further tuning of TB-QWIP parameters based on the analysis of this thesis hold promise for 100% increase of peak width by an applied biased.

KEYWORDS: Tunable Bandwidth Quantum Well Infrared Photo-Detector, TB-QWIP, Absorption, FTIR, I-V Characteristics, Photo Current, Responsivity, Detectivity, Background Limited, Tunability

APPLIED PHYSICS

IMPROVEMENT OF THE PERFORMANCE OF A TURBO-RAMJET ENGINE FOR UNMANNED AERIAL VEHICLES AND MISSILE APPLICATIONS

Dimitrios Krikellas-Captain, Hellenic Air Force

B.S., Hellenic Air Force Academy, 1993

B.S., National Technical University of Athens, 1999

Master of Science in Applied Physics-December 2003

Master of Science in Aeronautical Engineering-December 2003

Advisor: Garth V. Hobson, Department of Mechanical and Astronautical Engineering

Second Reader: Kai E. Woehler, Emeritus Professor

An existing turbo-ramjet engine was modified in order to increase the produced thrust and sustain combustion at increased freejet Mach numbers. The engine's afterburner fuel system was redesigned to improve the vaporization and atomization of the fuel. The engine performed satisfactorily at speeds up to Mach 0.3, producing 100% more thrust over the baseline turbojet. The data acquisition system of the turbo-ramjet engine's performance measurement in a freejet facility was also updated. Various computational fluid dynamics models of the flow through the turbo-ramjet engine were developed to visualize the flow and to predict the engine performance at different Mach numbers.

KEYWORDS: Turbo-Ramjet, Afterburner, UAV Propulsion, Missile Propulsion, Computational Fluid Dynamics, OVERFLOW, Freejet, Small-Scale Engines

DETERMINATION OF YOUNG'S MODULUS OF CARBON NANOTUBES USING MOLECULAR DYNAMICS SIMULATION

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B.S., Korea Military Academy, 1991

Master of Science in Applied Physics-December 2003

Advisors: Young W. Kwon, Department of Mechanical and Astronautical Engineering

James H. Luscombe, Department of Physics

Molecular dynamics simulations were performed to determine the Young's modulus of the single-walled carbon nanotubes (SWNT) and bamboo structural carbon nanotubes (BSNT) models generated from the basic structure characteristics of graphite. The empirical Tersoff-Brenner potential and freestanding thermal vibration methods proposed by Krishnan, et al., were used to determine inter-atomic forces and *rms* displacements of carbon atoms at room temperature ~300 K. The calculated average Young's modulus of SWNT and BSNT model were $\langle Y \rangle = 1.424$ and 0.604 TPa, respectively. In particular, the calculated Y value of the SWNT model is in good agreement with the previous measurements. Although, the evaluated Y value of the BSNT model, which represents heterogeneous nanotubes, was less than the pure the SWNT model, it still has strong and stiff mechanical properties compared with other general bulk materials such as hardened steel (210 GPa). CNTs hold a promising future for the variety of potential applications in the nanotechnology field.

KEYWORDS: Molecular Dynamics, MDSS, Carbon Nanotubes, SWNT, BSNT, Young's Modulus, Equilibrium Analysis, Non-Equilibrium Analysis, CNT, Tersoff-Brenner Potential, Freestanding Thermal Vibration Method

ACTIVE VIBRATION CONTROL FOR FREE ELECTRON LASERS

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Master of Science in Applied Physics-December 2003

Advisors: Bruce C. Denardo, Department of Physics

Thomas J. Hoffer, Department of Physics

This thesis is concerned with active control methods for stabilizing the mirror vibrations of free-electron laser weapons on ships so that the laser continues to deliver full power. Alignment of the mirrors is critical

for proper operation because the electron beam and optical mode must substantially overlap. The alignment is expected to be difficult to maintain in a shipboard environment. A theory for controlling the vibrations of a single-degree-of-freedom system is developed and checked by numerical simulations. An apparatus consisting of a flexing aluminum strip was constructed in order to probe the fundamental behavior of actual systems which eventually become unstable as the control gains are increased. A computer data acquisition system (LabVIEW) was implemented so that experiments could be more efficiently and accurately performed. Proportional and derivative controls were used to stabilize the motion of the strip. Experiments reveal that the derivative control behaves according to the theory. In particular, the instability is understood as the result of positive feedback due to a phase shift of the unstable mode. However, the instability due to the proportional control does not behave according to the theory. Improvements that would allow for greater control gains and thus greater stabilization are suggested.

KEYWORDS: Free-Electron Lasers, Active Control, Vibration Stabilization

MASTER OF SCIENCE IN APPLIED SCIENCE

ESTABLISHING A VIBRATION THRESHOLD VALUE, WHICH ENSURES A NEGLIGIBLE FALSE ALARM RATE FOR EACH GEAR IN CH-53 AIRCRAFT USING THE OPERATIONAL DATA

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B.S., Turkish Naval Academy, 1998

Master of Science in Applied Science-December 2003

Advisor: Samuel E. Buttrey, Department of Operations Research

Second Reader: Robert A. Koyak, Department of Operations Research

Rotating machinery, such as gears, plays an important role in control of an aircraft. The health of this machinery is a key ingredient to both platform safety and mission success, especially in military operations. The purpose of this thesis research is to establish a vibration threshold level for each particular gear in CH-53 aircraft such that, while minimizing in-flight risk, a negligible false alarm rate is obtained. This study uses Box-Jenkins time series modeling (ARMA) with regression, Mahalanobis distance metrics, goodness-of-fit tests, and the Bonferroni correction to explore the structure of the historical acquisition datasets for particular gear type and aircraft, to set vibration threshold values for "Warning" and "Alarm" situations. Although 28 datasets could not be modeled because of small sample sizes, the other 224 data sets were successfully modeled using ARMA with regression modeling techniques. The Mahalanobis distance metric was then used to set a threshold value of "Warning" and "Alarm" for each gear type. These threshold values were then checked with new data: 200 outliers for "Warning" and 69 outliers for "Alarm" were detected. These outliers might be evaluated as false alarms.

KEYWORDS: Box-Jenkins Time Series Modeling, ARMA, Mahalanobis Metric, Goodness of Fit Tests, Bonferroni Correction

MASTER OF SCIENCE IN ASTRONAUTICAL ENGINEERING

A LASER METROLOGY SYSTEM FOR PRECISION POINTING

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B.S., United States Air Force Academy, 1993

Master of Science in Astronautical Engineering-December 2003

Advisor: Brij N. Agrawal, Department of Mechanical and Astronautical Engineering

Second Reader: Hong-Jen Chen, National Research Council Research Associate

Precision spacecraft payloads are driving the need for fine pointing control and vibration cancellation. One implementation that provides pointing and disturbance control is the Stewart-Gough platform equipped with active sensing and actuating elements. The Precision Pointing Hexapod (PPH) at the Naval Postgraduate School (NPS) is exactly such a platform, initially installed with voice coil actuators and accelerometers on each strut by CSA Engineering, Inc. High pointing accuracy, however, requires an additional external sensing system that feeds back the accurate location and orientation information of the moving platform for control.

The first implementation by NPS of such sensing system is the eddy current metrology system. Currently, that system only provides measurement of the two degrees of motion that define the pointing direction and has issues such as questionable absolute pointing accuracy and lower resolution. This thesis seeks to develop a new laser metrology system, utilizing diode lasers and position sensing detectors, to provide all six degrees of freedom information of the platform motion at higher precision and accuracy. The tasks of developing the laser metrology system, from theory to design, fabrication, implementation, and verification, are documented in this thesis. Recommendations for future work and lessons learned are also captured.

KEYWORDS: Precision Pointing Hexapod, Stewart-Gough Platform, Stewart-Platform, PSD, Laser

FLEXIBLE MULTIBODY DYNAMICS AND CONTROL OF THE BIFOCAL RELAY MIRROR

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B.S., Purdue University, 1993

M.S.A., Central Michigan University, 2001

Astronautical Engineer-December 2003

Master of Science in Astronautical Engineering-December 2003

Advisor: Brij N. Agrawal, Department of Mechanical and Astronautical Engineering

Second Reader: Marcello Romano, National Research Council Research Associate

In recent years, spacecraft have become increasingly flexible. The design requirements for the Bifocal Relay Mirror spacecraft include controlling jitter at the nanoradian level. Typically, tight pointing requirements require high structural stiffness, at the cost of increasing the on-orbit mass. To accomplish this, while minimizing the mass of the spacecraft, the structure will have some inherent flexibility. These flexible modes will interact with the pointing control, hence affecting the payload performance. The compensator design conducted in this thesis achieves order of magnitude improvements in controlling the rate error, hence jitter. This thesis starts with a rigid body dynamic model, and develops a flexible body dynamic model. Once the model is developed, the structure-controls interaction is discussed. Finally, compensators are applied to the rigid body controller to mitigate the performance losses present in the flexible body system. Through classical second-order compensators, the angular rate error was decreased by a factor of ten. Nonminimum phase notch filters and phase lag filters were used. Ultimately, the phase lag filters provided the best performance.

KEYWORDS: Controls, Flexible, Flexibility, Structure, Compensator, Filter, Bifocal Relay Mirror, Modal, Modes, Laser, Satellite, Spacecraft, MATLAB, SIMULINK, Attitude

ASTRONAUTICAL ENGINEERING

DESIGN AND OPTIMIZATION OF HYPERSONIC TEST FACILITY FOR SUBSCALE TESTING

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B.S., University of Arizona, 1996**

Master of Science in Astronautical Engineering-December 2003

Advisor: Jose O. Sinibaldi, Department of Mechanical and Astronautical Engineering

Second Reader: Garth V. Hobson, Department of Mechanical and Astronautical Engineering

In this thesis, the Rocket Propulsion and Combustion Lab at the Naval Postgraduate School is evaluated to determine if the installed gas support systems are capable of supplying the operation of a hypersonic test stand. Trait analysis is performed on the installed systems and the results are compared to the in flight conditions that would be required by a hypersonic combustor. Additionally, a simple method is developed to allow other institutions to easily evaluate their facilities. A software model including Matlab and Simulink models is also included to create a seamless analysis and change prediction tool.

KEYWORDS: Hypersonic Test Facilities, Hypersonic Testing, Vitiated Air, Vitiator

TRANSMISSION OF A DETONATION WAVE ACROSS A SUDDEN EXPANSION WITH VARYING MIXTURE COMPOSITION

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Master of Science in Astronautical Engineering-December 2003

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Second Reader: Jose O. Sinibaldi, Department of Mechanical and Astronautical Engineering

Detonation waves were examined in axisymmetric and two-dimensional test configurations to determine the limits at which a detonation will successfully initiate and diffract from a small initiator tube into a larger main combustor. Tests were conducted for various initiator-to-main combustor area ratios. Additionally, for each area ratio, the fuel-oxygen initiator mixture was diluted with various nitrogen concentrations attempting to approach the mass fraction of nitrogen in air (79%).

Results of the axisymmetric testing showed that with an expansion area ratio of 2.0, detonations began to fail to initiate in the initiator section with nitrogen dilution as low as 45%. Although, through constructive interference such as wall reflections and shock-shock interactions, a detonation wave initiated in the main combustor for up to 60% nitrogen dilution. Results of the two-dimensional testing showed that for area ratios of 1.33 to 2.67, detonation waves successfully transmitted for all nitrogen dilution cases, including 79%. For an area ratio of 4.0, detonation waves successfully transmitted with 65% nitrogen dilution, but failed with 70% nitrogen dilution.

KEYWORDS: Pulse Detonation Engines, PDE, Detonation Diffraction

ANGULAR RATE ESTIMATION BY MULTIPLICATIVE KALMAN FILTERING TECHNIQUES

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Master of Science in Astronautical Engineering-December 2003

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Second Reader: Brij N. Agrawal, Department of Mechanical and Astronautical Engineering

Spacecraft attitude estimation and pointing accuracy have always been limited by imperfect sensors. The rate gyroscope is one of the most critical instruments used in spacecraft attitude estimation, and unfortunately, historical trends show this instrument degrades significantly with time. Degraded rate gyroscopes have impacted the missions for several NASA and ESA spacecraft, including the Hubble Telescope. A possible solution to this problem is using a mathematically modeled dynamic gyroscope in lieu of a real one. In this thesis, data from such a gyro is presented and integrated into a spacecraft attitude estimation algorithm.

The impediment to spacecraft attitude estimation presented by imperfect sensors has been overcome by developing more accurate sensors and using Kalman filters to reduce the effect of noisy measurements. Kalman filters for spacecraft attitude estimation have historically been based on an Euler angle or quaternion formulation. Though Euler angles and quaternions are arguably the easiest methods with which to describe the attitude of a spacecraft, other methods of describing attitudes do exist – including the Gibbs and Rodriguez parameters. A Kalman filter based upon the Gibbs parameter is presented and analyzed in this thesis.

KEYWORDS: Kalman Filter, Gibbs Parameter, Dynamic Gyroscope, Attitude Estimation

MASTER OF SCIENCE IN COMBAT SYSTEMS TECHNOLOGY

ATMOSPHERIC WINDOWS FOR HIGH ENERGY SHORT PULSE LASERS

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Master of Science in Combat Systems Technology-December 2003

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In this thesis, the authors aim to determine the optimal atmospheric windows for high energy, pico second, short pulse lasers. Computer simulations were carried out by convolving a pulse spectrum with the transmission spectrum and the absorption coefficient from the MODTRAN and FASCODE atmospheric codes. Transmission spectrum and absorption coefficient plots were compared to find the range of suitable wavelengths that give good transmittance and low absorption coefficient values. The molecular absorption spectrum was chosen over the extinction spectrum because of known limitations of the Navy Aerosol Model results incorporated into the MODTRAN and FASCODE calculations. Results showed that several suitable windows could be found within the 0.95 to 2.5 μm region that offer at least 90% transmittance with absorption coefficient values of not more than 0.02 per km. For 99% transmittance, optimal wavelengths are between 1.03 and 1.06 μm , and around 1.241 and 1.624 μm . However, the disadvantage of operating near the 1 μm region is the high aerosol extinction. The Navy Aerosol Model used in the atmospheric codes needs to be validated or replaced and actual aerosol data collected in the geographical areas of interest before a more accurate assessment of the optimal wavelengths can be made.

KEYWORDS: Atmospheric Transmission Spectrum, Optimal Wavelengths for Transmission of High Energy Lasers, MODTRAN and FASCODE Atmospheric Codes, Absorption Coefficient, Thermal Blooming

INVESTIGATION OF OUTER LENGTH SCALE IN OPTICAL TURBULENCE

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Atmospheric turbulence degrades the electromagnetic propagation medium and affects many military applications. The strength and spatial distribution of turbulence are critical parameters that arise in theoretical modeling and experimental situations. This thesis investigated three outer scales of turbulence using experimental data from two instruments: microthermal probes carried by a balloon and an acoustic sounder. The outer length scale is the size of the largest energy-containing eddy in a turbulent region of the atmosphere. The length scales considered were the thermal length scale l_h associated with temperature fluctuations, the momentum length scale l_m , which represents the size of the velocity fluctuations and the boundary thermal convective cell size. The microthermal balloon data had excessive scatter when the thermal outer scale was expressed in terms of the gradient Richardson number. A reasonable functional relationship was not found and unrealistic outer scales $l_h > 1000\text{m}$ and $Ri_g > 100$ prevailed. The primary reason was that inadequate sampling of the turbulent layers prevented the computation of valid statistical averages. The volume backscatter cross-section measured by an acoustic sounder provided better statistical averaging of the optical structure parameter C_n^2 than the microthermal balloon data. The separation of daytime convective thermal plumes was found from the acoustic sounder data by computing average C_n^2

COMBAT SYSTEMS TECHNOLOGY

values between 20 to 50 meters for each acoustic pulse and performing an autocorrelation of these averages over 600 seconds. Multiplying the autocorrelation time by the wind speed gave the separation between the convective thermal maxima and their minima. The mean correlation length for March 2002 at the Starfire Optical Range was 1590 ± 770 meters, between 1000 and 1600 local time. This length is proportional to the convective thermal cell size and to the boundary layer inversion height. A smaller length scale of 200 meters also appeared in the acoustic sounder data associated with the local height of the data and the hill above the ground.

KEYWORDS: Atmospheric Structure Parameter, Atmospheric Turbulence, Outer Length Scale, Richardson Number, Acoustic Sounder, Thermosonde, Optical Turbulence

DIGITAL ENHANCEMENT OF NIGHT VISION AND THERMAL IMAGES

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Low image contrast limits the amount of information conveyed to the user. With the proliferation of digital imagery and computer interface between man-and-machine, it is now viable to consider digitally enhancing the image before presenting it to the user, thus increasing the information throughput. This thesis explores the effect of the Contrast Limited Adaptive Histogram Equalization (CLAHE) process on night vision and thermal images. With better contrast, target detection and discrimination can be improved. The contrast enhancement by CLAHE is visually significant and details are easier to detect with the higher image contrast. Analyzing the image frequency response reveals increases in the higher spatial frequencies. As higher frequencies correspond to image edges, the power increase is viewed as corresponding to edge enhancement and hence, an increase in visible image details. This edge enhancement is perceived as improvement in image quality. This is further substantiated by a subjective testing, where a majority of human subjects agreed that CLAHE-enhanced images are more informative than the original night vision images.

KEYWORDS: Image Enhancement, Night Vision Images, Contrast Limited Adaptive Histogram Equalization, CLAHE, Contrast Enhancement, Image Quality Assessment

TESTING AND PERFORMANCE CHARACTERIZATION OF THE SPLIT-FIELD POLARIMETER IN THE 3-5MM WAVEBAND

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The infrared (IR) radiation emitted or reflected in an off-normal direction from a smooth surface is partially polarized. This principle can be used for enhanced discrimination of targets from backgrounds in a marine environment. It has been shown that (man-made) targets do not demonstrate a pronounced polarization effect when observed at near normal exitance, whereas the sea background radiation has a significant degree of polarization in slant observation directions.

The NPS split-field polarimeter was previously designed and constructed to provide simultaneous image pairs in a single frame, differing only in the direction of linear polarization. The system can operate in both long wavelength (8-12 μm) and the mid wavelength (3-5 μm) with interchangeable polarizing splitter plates.

In this thesis, tests were conducted to visually compare the polarizing effect on objects in the 3-5 μm waveband using the polarimeter and with the external polarizer. The image recorded in the laboratory with the horizontal and vertical polarizations depicts a contrast enhancement differing with varied aspects of the target. With the successful demonstration of the polarimeter operability, the performance of the thermal

imager operated with and without the polarimeter was characterized by measuring its Minimum Resolvable Temperature Difference (MRTD) as a function of different spatial frequency. The measured performance was then compared against the same thermal imager using an external polarizer. The measured MRTD curve is used to model the system detection and recognition range using the Johnson criteria.

KEYWORDS: Thermal Imaging, Polarization, Infrared Radiation, Split-Field Polarimeter

MASTER OF SCIENCE IN COMPUTER SCIENCE

WEB PORTAL DESIGN, EXECUTION, AND SUSTAINABILITY FOR NAVAL WEBSITES AND WEB SERVICES

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With the rapid evolution of Web-based technologies, keeping up with the latest trends is a complicated process. The newest "Web Service" is the development of Web Portals. Portals allow the design of Web Services in such a way as to allow the users to define their needs, and create a home of their own within a site. As users become more proficient, knowledgeable and demanding, this technology will expand due to the demand of users.

As with all new technology, it includes significant benefits and pitfalls. Determining where to best use Web Services and Portals is important. The plethora of tools being promoted for the development of portals is significant, and choosing the right tool to accomplish the task while ensuring compatibility is critical. Already, considerable work has been accomplished by Task Force Web and the Fleet Numerical Meteorology and Oceanography Center. An important factor in the decision process is meeting the demands of an ever increasing technology literate environment. Reaching the goal of a fully connected Navy will require significant expenditure of money and manpower, but will reap large benefits from the long-term value of improved training and access to knowledge.

This research looks at Web Services and Web Portals, examining the design of portals and an evaluation of their use.

KEYWORDS: Web Services, Web Portals, NEP, Navy Enterprise Portal

THERMINATOR: CONFIGURING THE UNDERLYING STATISTICAL MECHANICS MODEL

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Master of Science in Computer Science-December 2003

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The rapid increase in sophisticated Internet attacks has left the security industry lagging far behind. In an attempt to improve network security, Terminator, a patternless intrusion detection system, was developed in 2001 by NPS in conjunction with NSA. The Terminator model uses statistical mechanics to analyze network traffic as a system of exchanges. Being highly configurable enables Terminator to be adapted for any network configuration. Until now, however, no exploration had been conducted on the configuration parameters of the underlying statistical mechanics model. It is important to understand the effects of these parameters to optimize anomaly detection. Thus, the current study explored these parameters using HTTP traffic generated in a controlled test environment. Results were as follows: equations were developed for state counting to determine bucket state space sizes; bucket state space size was found to be symmetrical about the midpoint of the boundary conditions; proper display period was based on traffic rate; and lastly, the more orthogonal anomalous traffic was to the normal traffic, the larger the perturbation was in the state graph. These results provide needed insight into properly configuring Terminator for optimal anomaly detection, ultimately affording the Department of Defense greater network security.

KEYWORDS: Network Security, Network Assurance, Information Protection, Intrusion Detection, Patternless Intrusion Detection, Network Anomaly Detection, Real-Time Network Monitoring, Statistical Mechanics

EVALUATION OF A MULTI-AGENT SYSTEM FOR SIMULATION AND ANALYSIS OF DISTRIBUTED DENIAL-OF-SERVICE ATTACKS

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Distributed Denial-of-Service (DDoS) attack is evolving at a rapid and alarming rate. An effective solution must be formulated using an adaptive approach. Most of the simulations are performed at the attack phase of the DDoS attack, thus the defense techniques developed focus mainly on filtering and isolating the attack. In order to develop and verify the effectiveness of a defense strategy, a robust and flexible simulation tool is needed. The Multi-Agent System Development Kit (MASDK) provided a means to generate DDoS attack in a safe experimental environment for testing and validating security solutions, starting from the implantation phase: this allows researchers to develop new defense strategy even before the DDoS attack is launched. The paper begins with the study of the characteristics of DDoS attacks, the types of detection-and-response techniques, and the available DDoS attack simulation tools. The result generated by the MASDK simulation tool was used to evaluate the performance of the tool in simulating the DDoS attack over the networking environment.

KEYWORDS: DDoS, MASDK, Simulation Tool, Attack Tool, Computer Network

SIMULATING DISTRIBUTED OBJECT ORIENTED SERVERS

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Distributed object oriented (OO) computing such as RMI, COBRA, and SOAP, etc., is fast becoming the de-facto standard for software development. Distributed OO systems can consist of multiple object servers and client applications on a network computer, as opposed to a single large centralized object server.

The aim of the system designer is to determine the optimal deployment strategy for the system to perform efficiently. This is an enormous task, especially when multiple object servers are fielded on hardware of different specifications. The number of possible deployment strategies of object servers to hardware grows exponentially with increased numbers of object servers and machines. For example, with three machines and ten object servers there are 59,049 possible deployment patterns. Eventually, the number of possible deployments makes it impossible for system designers to setup test beds to determine the optimal deployment strategy.

The main goal of the simulation model is to analyze the object server deployment, verify an existing optimization model, and determine the optimal deployment strategy that will reduce the client response time. In one of the experiments conducted with the simulation model, in an environment with three machines and ten object servers, it will take 53 years to attempt all deployment patterns in the lab environment. The simulation model will take only 13 days, which is an improvement of 1480%.

KEYWORDS: Distributed Object Oriented Architecture, Simulation, OMNet++, Optimization

SCENARIO SELECTION AND STUDENT ASSESSMENT MODULES FOR CYBERCIEGE

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CyberCIEGE aims to provide an Information Assurance (IA) teaching/learning laboratory in the form of an interactive, entertaining, commercial-grade, PC-based computer game. Each game plays as a single scenario that serves to teach a particular IA concept. However, more synergy can be gained if there is higher-order organization of these scenarios, such as by grouping around a set of desired concepts to be taught, or by increasing the complexity of the scenarios built around a common theme. This thesis aims to provide an instructor tool for this purpose.

In addition, by tapping the CyberCIEGE event log files generated at the end of each game, the game's progress can be reconstructed to support After Action Reviews (AAR) to assist the instructor and student in analyzing game decisions and the student's progress. This provides a constructive follow-up to review and reinforce the concepts being taught. ■

KEYWORDS: Information Assurance, Security Education, After Action Review

A METHODOLOGY FOR DEVELOPING TIMING CONSTRAINTS FOR THE BALLISTIC MISSILE DEFENSE SYSTEM

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The Department of Defense (DoD) is developing a Ballistic Missile Defense System (BMDS) based on a layered defense that employs complementary sensors, weapons, and C2 elements, integrated by software into a system-of-systems to engage and destroy threat ballistic missiles through all phases of flight. Inherent to the ultimate success of the BMDS will be the timely execution of the kill chain process against threat ballistic missiles.

In this thesis, the Unified Software Development Process (USDP) is applied, utilizing the BMDS as a case study to investigate a means to identify and validate timing behaviors and constraints of system-of-systems. In particular, the information exchange needed for processors to share, collaborate, fuse, and distribute sensor information in a distributed sensor network is examined, and modeling and simulation to provide insight into the timing aspects of interactions among subsystems comprising a system-of-systems is utilized. The case study will involve deriving and documenting system and software requirements, developing a test-ready model for representing the timing requirements, and then validating this model through the use of an OMNET++ simulation. The simulation will then be used to provide feedback to further refine the system requirements and the functional specifications of the subsystems.

KEYWORDS: Software Engineering, System-of-Systems, Ballistic Missile Defense System, BMDS, Sensor Fusion, Collaborative Fusion, Modeling, Simulation, OMNeT++, UML-RT, Real-Time Constraints, Software Requirements, Kill Chain, Timing Requirements, Unified Software Development Process, USDP

FREE SPACE OPTICS COMMUNICATION FOR MOBILE MILITARY PLATFORMS

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Free Space Optics (FSO) is widely regarded as the next-generation high-speed wireless communication technology. FSO has demonstrated its capability to deliver data faster than any other state-of-the-art wireless communication technology. Today, terrestrial FSO links are able to reach 150 kilometers; unmultiplexed data rates of 2.5 Gbps have been achieved; Acquisition, Pointing, and Tracking (APT) systems have been successfully deployed between communication satellites; and carrier-class availability is being offered by FSO vendors. However, FSO has not seen widespread use in the military. This is attributed to the fact that military platforms are largely mobile, while the progress in the commercial arena has largely been confined to links between fixed sites.

This thesis analyzes the features of FSO technology while being mindful of how these apply to the military. These features include the bandwidth, spectrum use, bit error rates, communications security, free-space loss, and power consumption. The limitations and challenges presented by atmospheric effects, directional precision, line-of-sight obstructions, and laser safety are also studied. A final section looks at the acquisition, pointing, and tracking mechanisms that are necessary for deploying FSO on mobile platforms.

KEYWORDS: Free Space Optics, FSO, Laser Communications

INTEGRATION OF THE NAVY TACTICAL ENVIRONMENTAL DATABASE SERVICES WITH THE JOINT EFFECTS MODEL

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The Oceanographer of the Navy is responsible for the maintenance and distribution of the "4-D cube" of environmental data, the Virtual Natural Environment, using an object oriented database and distribution system, Tactical Environmental Database Services (TEDServices). The new military dispersion modeling capability within the military is called the Joint Effects Model (JEM), and has to have an interface created to allow inclusion of weather data in JEM. This thesis utilizes TEDServices using web protocols to query for available data, and then retrieves the required meteorology data. The software creates a specifically formatted file to be used in JEM. It is now fully functional and submitted to Space and Warfare Command for inclusion in JEM. Much of the testing was to ensure that the data are available and within the reasonable meteorological standards. The thesis also suggests additional changes that should be made to TEDServices to make it more capable of storing and serving environmental data.

KEYWORDS: REA, JEM, Dispersion Model, TEDServices, HPAC, Mesoscale Model

COMPUTER SCIENCE

DEFENDING IEEE 802.11-BASED NETWORKS AGAINST DENIAL OF SERVICE ATTACKS

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The convenience of IEEE 802.11-based wireless access networks has led to widespread deployment in the consumer, industrial, and military sectors. However, this use is predicated on an implicit assumption of confidentiality and availability. In addition to widely publicized security flaws in IEEE 802.11's basic confidentiality mechanisms, the threats to network availability presents an equal, if not greater, danger to users of IEEE 802.11-based networks. It has been successfully demonstrated that IEEE 802.11 is highly susceptible to malicious denial-of-service (DoS) attacks targeting its management and media access protocols.

Computer simulation models have proven to be effective tools in the study of cause and effect in numerous fields. This thesis involved the design and implementation of a IEEE 802.11-based simulation model using OMNeT++, to investigate the effects of different types of DoS attacks on a IEEE 802.11 network, and the effectiveness of corresponding countermeasures.

KEYWORDS: IEEE 802.11, WLAN, Wireless LAN, Protocol, Computer Security, Denial of Service, Simulation, OMNeT

CONFRONTING CYBERTERRORISM WITH CYBER DECEPTION

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Second Reader: Dorothy E. Denning, Department of Defense Analysis

This thesis concerns the possibility of deceiving cyberterrorists using defensive deception methods. As cyberspace today is a battleground for a myriad of cyber attacks and intrusions, it may only be a matter of time before terrorists choose to advance their deadly cause in cyberspace. Some of the questions raised regarding the threat of cyberterrorism are explored by examining different perspectives, motivations, actors, targets, and how they may be confronted. One way is to draw from the lessons of deception and apply them against cyberterrorist attacks. Cyber deception applies in cyberspace just as well as deception in military battles. From the different categories of attackers that could perpetrate cyberterrorism, the ways in which they may be deceived are examined. Many of the methods and tools that cyberterrorists would use are similar to those used by other less malicious hackers, so specific deceptions to use against them in advance can be planned.

KEYWORDS: Cyberterrorism, Terrorism, Deception, Cyber Deception, Intelligent Software Decoys, Software Deception, Information Warfare, Cyber Attacks

EFFECTIVE DISTRIBUTION OF HIGH BANDWIDTH TO THE LAST MILE

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Since the mid 1990s, the Internet has been revolutionizing the way business is conducted around the globe. Bandwidth-intensive graphics, video, and audio applications are becoming more popular and the desire for fast access to information places a huge demand on high bandwidth in metro networks. The primary bottleneck in the quest for delivering high bandwidth to the customers is the last mile. The last-mile of today primarily relies on infrastructures that were not designed for the transport of digital data. The current

infrastructure of twisted pair is very close to its upper limits. As a result, consumers are unable to enjoy the full potential of the Internet, and generally do not have access to enhanced services such as enriched multimedia services, converged voice, video, and data services, and high-speed Web browsing.

This thesis assesses a broad spectrum of wired and wireless last mile technologies available - Optical Fiber Technology, Digital Subscriber Lines, Free Space Optics, Wireless Local Loop, Wireless LAN, and Cellular Technology. Besides discussing the basic concepts and principles, this thesis highlights the current limitations of these technologies for last mile implementation. An innovative and state-of-the-art methodology for linking building with optical fiber to achieve high bandwidth through sewer systems is presented.

KEYWORDS: Last Mile Technologies, Optical Fiber, Digital Subscriber Line, Free Space Optics, Wireless Local Loop, Wireless Local Area Network, Cellular Technology, Fiber in Sewer

MASTER OF SCIENCE IN CONTRACT MANAGEMENT

IMPLEMENTING KNOWLEDGE MANAGEMENT AS A STRATEGIC INITIATIVE

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Master of Science in Contract Management-December 2003

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This research is intended as an implementation guide for managers to apply knowledge management as a strategic initiative within the contracting element of a major system command. The study incorporates the four-pillar model of knowledge management developed by Dr. Michael Stankosky. The four pillars within the model are: leadership, organization, technology, and learning. Knowledge management was one of five strategic initiatives in the overall strategic plan, which was developed using Kaplan and Norton's Balanced Scorecard methodology. The thesis discusses the elements of knowledge management as well as how contracting organizations can be improved by incorporating knowledge management as a strategic initiative.

KEYWORDS: Knowledge Management, Contracting, Procurement, Strategic Initiative

MASTER OF SCIENCE IN DEFENSE ANALYSIS

REBUILDING AFGHANISTAN: COUNTERINSURGENCY AND RECONSTRUCTION IN OPERATION ENDURING FREEDOM

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International efforts at the stabilization and reconstruction of Afghanistan are confronted by a paradox in their strategy for Operation ENDURING FREEDOM that has crippled their ability to locate and defeat the enemy and establish stability. In their narrowly focused pursuit of the strategy of attrition, coalition military forces have neglected the fundamental principle that guides small wars: that the protection of the population and the elimination of the influence of the insurgent forces are paramount to gathering the necessary intelligence to locate the threat. The disregard for the control of the population has eliminated the coalition's primary source of intelligence, directly impinging on its ability to locate or separate the insurgents from the population and trapping it in an operational quagmire. Additionally, international aid efforts have focused on short-term relief rather than long-term reconstruction, establishing the foundation for continued dependence and instability rather than self-sufficiency. The purpose of this thesis is not to limit or narrowly define the threat in Afghanistan as an insurgency, but to illustrate how the situation, when framed in terms of an insurgency, can be effectively managed and the threats eliminated to produce a stable and self-sustaining country on the world stage.

KEYWORDS: Counterinsurgency, Reconstruction, Afghanistan, Malaya, Philippines, Vietnam, Enduring Freedom

TERRORIST APPROACH TO INFORMATION OPERATIONS

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This thesis provides insight into how terrorist organizations exploit the information environment to achieve their objectives. The study establishes an analytical Information Operations (IO) framework, by integrating U.S. military doctrine with a fundamental approach to IO theory. The framework proves useful in examining the IO tools terrorists have assembled and how they implement them to influence their target audiences. The thesis shows that terrorists are, indeed, naturally linked to the information environment by their nature and strategy. Generally speaking, all terrorists employ IO tactically to enhance their operations. However, many organizations have a profound understanding of the information environment and also have the ability to manipulate information to achieve their objectives. Since terrorist organizations are militarily weaker than the states they face and cannot rely on physical attacks to accomplish their goals, they must adopt an information strategy to achieve their objectives. This thesis emphasizes three primary conclusions. First, terrorists conduct violent attacks in the physical environment to enable operations in the information environment. Second, terrorists integrate offensive and defensive IO to survive and appear legitimate to potential supporters and to the state. Finally, terrorists intentionally target four different audiences, opposing, uncommitted, sympathetic, and active, to psychologically influence their perceptions.

DEFENSE ANALYSIS

KEYWORDS: Information Operations, Information Warfare, Terrorism, Counter-Terrorism, Intelligence, Counter-Intelligence

AMPHIBIOUS AND SPECIAL OPERATIONS IN THE AEGEAN SEA 1943-1945: OPERATIONAL EFFECTIVENESS AND STRATEGIC IMPLICATIONS

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Master of Science in Defense Analysis-December 2003

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The Aegean Sea during the Second World War drew the attention of both the Allies and the Axis. However, although historians have chronicled the fall of Greece and Crete in the spring of 1941, little attention has been given to the war in the Aegean after 1941. From the early days of the Mediterranean war, Churchill especially believed that the elimination of the Italian occupation of the Dodecanese Islands would facilitate British operations in the Eastern Mediterranean and help to convince Turkey to enter the war on the Allied side. When, in the autumn of 1943, Churchill sought to realize these goals, he succeeded only in creating an operational disaster and provoking a minor crisis between the Western Allies.

For the British, the Italian surrender of September 1943 provided a window of opportunity to thrust through the Aegean into Greece and the Balkans. The Americans firmly rejected Churchill's proposals for operations in the Eastern Mediterranean as designed to serve British imperial interests, rather than those of the rapid defeat of Germany. Despite failure to secure U.S. support, Churchill nevertheless proceeded with operations against Kos and Leros, with disastrous results. However, the British were more fortunate in conducting special operations in the Aegean and against Crete in 1943 and 1944 to the end of the war. This thesis follows the main events that affected the Aegean Sea in the war, stressing issues of inter-allied relations, peripheral strategy, tactical solutions to strategic problems, and special operations.

KEYWORDS: 1943-1945, Aegean Sea, Dodecanese Islands, British Interests, Special Operations, Inter-Allied Relations

THE UNITED STATES AND ASSASSINATION POLICY: DILUTING THE ABSOLUTE

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After two years fighting the "war on terror," the U.S. has reached a crossroads with its policy regarding assassination. Executive Order 12333, which explicitly and absolutely prohibits assassination, is still in effect. The ban, however, has been diluted and circumvented since its inception. Past administrations have targeted enemy leaders with "indirect" strikes, such as the 1986 attacks against Libya and the 1998 missile strikes in Afghanistan and Sudan. Currently, the U.S. deliberately targets individual enemies, whether in the context of an armed conflict, such as Afghanistan or Iraq, or in the War on Terror, such as the November 2002 Predator Hellfire missile strike in Yemen. This ostensibly duplicitous policy has caused controversy for the U.S., both internally among policy makers, military leaders, operatives, and the American public, and externally with the international community.

This thesis examines U.S. assassination policy in detail, and proposes recommendations for modernizing the Executive Order. The intent is to provide decision makers with a clear point of reference, and a framework for determining when assassination is the best - or at a very minimum the "least bad" - possible option for dealing with the complex and dangerous threats of modern conflict.

KEYWORDS: Assassination, War on Terror, Targeted Killing, Executive Order 12333, Yemen Predator Operation

DEFENSE ANALYSIS

AIR FORCE TARGETING REFORM: ADDRESSING THE NEED FOR CHANGE

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One prevailing trend characterizing U.S. operations has been the emphasis on overwhelming military strength and technologies. Heavy reliance on sophisticated weaponry as the JDAM, TLAM, CALCM, and other precision weapons during recent conflicts helps illustrate this present trend. Precision guided munitions, in combination with advanced technology, led the U.S. Air Force to measure success by counting total numbers of sorties flown and tonnage of ordnance employed versus assessing the effects that were achieved and goals obtained. However, as accurate as these "smart" weapon systems have become, without the benefit of a "smart" targeting process to identify the best means to employ these high tech solutions, their tremendous advantages in war are irrelevant. Targeting is a concept that is bound to and defines the very concept of airpower. Without a concept of targeting, the concept of airpower loses all meaning. Currently, the Air Force lacks overarching vision as to how the targeting process and those that perform this vital military function fit into the larger Air Force architecture. This lack of commitment to targeting negates the enormous advantages of America's sophisticated combat arsenal and if uncorrected, offsets the advantages of the precision and technology upon which so much faith is placed.

KEYWORDS: Targeting, Air Force Targeting, Targeteer, Targeting Specialist

MASTER OF SCIENCE IN ELECTRICAL ENGINEERING

THERMINATOR: CONFIGURING THE UNDERLYING STATISTICAL MECHANICS MODEL

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Master of Science in Electrical Engineering-December 2003

Master of Science in Computer Science-December 2003

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The rapid increase in sophisticated Internet attacks has left the security industry lagging far behind. In an attempt to improve network security, Terminator, a patternless intrusion detection system, was developed in 2001 by NPS in conjunction with NSA. The Terminator model uses statistical mechanics to analyze network traffic as a system of exchanges. Being highly configurable enables Terminator to be adapted for any network configuration. Until now, however, no exploration had been conducted on the configuration parameters of the underlying statistical mechanics model. It is important to understand the effects of these parameters to optimize anomaly detection. Thus, the current study explored these parameters using HTTP traffic generated in a controlled test environment. Results were as follows: equations were developed for state counting to determine bucket state space sizes; bucket state space size was found to be symmetrical about the midpoint of the boundary conditions; proper display period was based on traffic rate; and lastly, the more orthogonal anomalous traffic was to the normal traffic, the larger the perturbation was in the state graph. These results provide needed insight into properly configuring Terminator for optimal anomaly detection, ultimately affording the Department of Defense greater network security.

KEYWORDS: Network Security, Network Assurance, Information Protection, Intrusion Detection, Patternless Intrusion Detection, Network Anomaly Detection, Real-Time Network Monitoring, Statistical Mechanics

TESTING AND EVALUATION OF THE CONFIGURABLE FAULT TOLERANT PROCESSOR (CFTP) FOR SPACE-BASED APPLICATIONS

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Alan A. Ross, Navy Tactical Exploitation of National Capabilities (TENCAP) Chair

With the complexity of digital systems, reliability considerations are important. In many digital systems, it is desirable to continuously monitor, exercise, and test the system in order to determine whether the system is performing as desired. Such monitoring may enable automatic detection of failures via periodic testing or through the use of codes and checking circuits (e.g., built-in self-testing). While any complex system requires testing to ensure satisfactory performance, satellite systems require extensive testing for two additional reasons: they operate in an environment considerably different from that in which they were built, and after launch they are inaccessible to routine maintenance and repair. Because of these unique requirements, a specific solution is required, such as a self-contained, autonomous, self-testing circuit. The focus of this thesis is on the design and development of a series of Built-In Self-Tests (BISTs) for use with the Configurable Fault Tolerant Processor (CFTP). The results of this thesis are two detailed designs for a Random Access Memory (RAM) BIST and a Read-Only Memory (ROM) BIST, as well as a conceptual design for a Field Programmable Gate Array (FPGA) BIST. These designs are stored on board the CFTP and are made to operate remotely and autonomously. Together, these BISTs provide a means to monitor, exercise, and test the CFTP components and thus facilitate a reliable design.

ELECTRICAL ENGINEERING

KEYWORDS: Field-Programmable Gate Array, FPGA, Built-In Self-Test, BIST, FPGA Testing, Read-Only Memory Testing, ROM Testing, Random Access Memory Testing, RAM Testing, System Diagnosis, System Reliability

EFFECTS OF RADIOWAVE PROPAGATION IN URBANIZED AREAS ON UNMANNED AERIAL VEHICLE-GROUND CONTROL STATION COMMAND AND CONTROL

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Second Reader: Jeffrey B. Knorr, Department of Electrical and Computer Engineering

The purpose of this research was to examine the effects of radiowave propagation in urbanized areas on unmanned aerial vehicle-ground control station (UAV-GCS) command and control.

Operating at high frequency has merits of higher data rate transfer, which is crucial to support the large quantity of voice and video data to be transmitted via UAV-GCS linkage. However, high frequencies are attenuated more rapidly in glossy materials and weather. Having a shorter operational range translates to a smaller RF spread radius, and thus lowers the susceptibility to detection and jamming.

The software, Urbana, was used to investigate the propagation of radio signals in urban environments under varying conditions. Simulations were conducted for a small group of buildings and a large collection of buildings representative of a big city. The data clearly illustrate the effect of "urban canyons" and diffraction around buildings.

An UAV deployed for military operations in urban terrain (MOUT) must have the inherent capability to hover or fly at low speeds to be able to adapt to the dynamic urban environment and to capitalize on communications opportunities. Simulations show that a single UAV hovering at three times the height of the tallest building in the central city was found to provide concentric, uniform signal coverage.

KEYWORDS: Unmanned Aerial Vehicles, Urbana Wireless Toolset, Propagation Models, Airborne Communications Node, Portable Ground Control System

BENCHMARKING AND ANALYSIS OF THE SRC-6E RECONFIGURABLE COMPUTING SYSTEM

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This thesis evaluates the usefulness of the SRC-6E reconfigurable computing system for a radar signal processing application and documents the process of creating and importing VHDL code to configure the user definable logic on the SRC-6E. A false target radar imaging algorithm is chosen and implemented on the SRC-6E. Data from alternative computational approaches to the same problem are compared to determine the effectiveness of the SRC-6E solution. The results show that the implementation of the algorithm does not provide an effective solution when executed on the SRC-6E. An evaluation of the SRC-6E difficulty of use is conducted, including a discussion of required skills, experience, and development times. The algorithm test code and collected data are included as appendices.

KEYWORDS: Benchmark, Reconfigurable Computing, VHDL, SRC-6E, FPGA, False Radar Target Synthesis

ELECTRICAL ENGINEERING

RECURSIVE PARAMETER IDENTIFICATION FOR ESTIMATING AND DISPLAYING MANEUVERING VESSEL PATH

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Real-time recursive parameter identification is applied to surface vessel modeling for maneuvering path prediction. An end-to-end system is developed to simulate vessel motion, identify vessel parameters, and estimate future path. Path prediction improves bridge team situational awareness by providing a real-time depiction of future motion over the ground on an electronic chart and display system (ECDIS). The extended least-squares (ELS) parameter identification approach allows the system to be installed on most platforms without prior knowledge of system dynamics, provided vessel states are available. The system continually tunes to actual environmental conditions, including vessel ballasting, current, wind, and sensor biases. In addition to path prediction, the system estimates maximum vessel roll angle during maneuvering. Maximum roll prediction enhances carrier flight deck safety and increases operational effectiveness by reducing sea room-requirements. Suitable performance is demonstrated in real world maneuvering conditions to recommend that maneuvering path prediction be incorporated into the U.S. Navy's AN/SSN-6 Navigation Sensor System Interface (NAVSSI) electronic charting system. Future research should emphasize an underway demonstration with real-time data acquisition.

KEYWORDS: Recursive Parameter Estimation, Electronic Chart and Display System, ECDIS, ECN, AN/SSN-6, NAVSSI, Vessel Dynamic Model, Path Prediction

TRIPLE MODULAR REDUNDANCY (TMR) IN A CONFIGURABLE FAULT-TOLERANT PROCESSOR (CFTP) FOR SPACE APPLICATIONS

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Without the protection of atmosphere, space systems have to mitigate radiation effects. Several different technologies are used to deal with different radiation effects in order to keep the space device working properly. One of the radiation effects, called Single Event Upset (SEU), can change the state of a component or data on the bus. A single error could possibly cause a system failure if it is not corrected.

Besides error correction, a space system also needs the flexibility to be modified or upgraded easily. Consequently, the idea of having a TMR design instantiated in an FPGA to construct a Configurable Fault-Tolerant Processor (CFTP) developed. The TMR, which runs one program in three identical soft-core processors with voters, is a scheme used to mitigate an SEU. The full design of TMR running in an FPGA functions as a System-On-a-Chip (SOC). Both soft-core processor and FPGA offer the CFTP a great flexibility to be reconfigured.

A complete TMR design includes some fundamental components besides processors and voters, such as the *Reconciler*, *Interrupt* and *Error Syndrome Storage Device (ESSD)*. These components have their unique function in the TMR design. They are created and simulated. It is important to always keep in mind factors that affect test bench settings, such as processor pipelining. A component is designed to implement proper functions first. Then it is revised to work with the processor and memory. The full design for the TMR in this thesis proves its ability to detect and correct an SEU. The follow-on research suggested is to improve the efficiency and performance of this design.

KEYWORDS: Single Event Upset, SEU, Configurable Fault-Tolerant Processor, CFTP, TMR, FPGA, System-On-a-Chip, SOC, Reconciler, Interrupt and Error Syndrome Storage Device, ESSD

MASTER OF SCIENCE IN ENGINEERING ACOUSTICS

FAR FIELD EXTRAPOLATION TECHNIQUE USING CHIEF ENCLOSING SPHERE DEDUCED PRESSURES AND VELOCITIES

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Advisor: Steve Baker, Department of Physics

In this thesis, a technique of extrapolating near field measurement data to achieve device far field performance is undertaken. A Combined Helmholtz Integral Equation Formulation (CHIEF)-defined enclosing sphere placed around an acoustic projector is used to calculate far field response data from near field measurements. Pressure response data at a specified frequency is obtained from a near field linear array. Helmholtz integral relations for the enclosing sphere and integrals of the free-space Green's function and its gradient for defined near field point locations are used along with physical assumptions to form an overdetermined system. The overdetermined system is solved via least squares yielding values of pressure and velocity corresponding to defined locations on the enclosing sphere. The enclosing sphere's values of pressures and velocities are then used with integrals of the free-space Green's function and its gradient to calculate far field response.

KEYWORDS: Near Field, Far Field, CHIEF, Least Squares, Combined Helmholtz Integral Equation Formulation, USRD

CONSTRUCTION AND TESTING OF LOW-NOISE HYDROPHONES

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Master of Science in Engineering Acoustics-December 2003

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Andres Larraza, Department of Physics

Several hydrophones have been constructed exploiting the advantages of the MiniCan design. One of them is unamplified and two are amplified. Comparisons of sensitivity, self-noise, size, and price with known and reliable commercial hydrophones yield the following results. The unamplified MiniCan has a sensitivity 22 dB re 1 V/ μ Pa higher than a Brüel & Kjær (B&K) type 8103 up to 20 KHz and the amplified MiniCans are comparable to their similar and relatively expensive commercial hydrophones. The self-noise level of the amplified MiniCans is significantly lower than those of the B&K 8106 and Reson TC4032. The size of these preamplified MiniCan units is at least 18 times smaller in volume than the largest of the aforementioned. Moreover, the cost of the piezoceramic material and electronics components is around \$30 USD, compared to purchase prices of \$3095 and \$2500 USD for the B&K 8106 and Reson TC4032, respectively. The analysis shows a cheaper and smaller hydrophone, which is more sensitive than a typical hydrophone and has better self-noise than the least noisy commercial hydrophone in the market.

KEYWORDS: Hydrophone, Sound Receiver, Transducer

ENGINEERING ACOUSTICS

SOURCE/RECEIVER MOTION-INDUCED DOPPLER INFLUENCE ON THE BANDWIDTH OF SINUSOIDAL SIGNALS

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Second Reader: Roy L. Streit, Naval Undersea Warfare Center

Most self-propelled vessels moving on, or under, the ocean surface, contain rotating machinery that radiate finite bandwidth signals into the water. Empirical evidence suggests that the signal bandwidth estimated with a far field receiver is often greater than expected. This thesis investigates the use of an acoustic propagation model to predict the received bandwidth of sinusoidal signals when both the source and the receiver are in motion. The bandwidth parameter is calculated from the multi-frequency transmission loss (TL) predicted with a re-written version of K. Smith's Monterey-Miami Parabolic Equation (MMPE) model, including both receiver and source motion. The results for various propagation environments allow exploration of the characteristics of received bandwidth, predicted from sources on the surface or at depth. The dependency of aggregate bandwidth upon conditional parameters such as range, depth, and normalized pressure are also evaluated. In addition to modeling results, this thesis documents a new implementation of the MMPE model for narrowband signals using only the MATLAB programming language. A MATLAB version has the inherent advantages of increased flexibility and portability. A MATLAB implementation of a range dependent ray trace function based upon a Runge-Kutta integration of the eikonal equations is also presented.

KEYWORDS: Source, Receiver, Motion, Doppler, Signal, Bandwidth, Parabolic Equation, Acoustic, Propagation, Model

UNDERWATER MULTIMODE DIRECTIONAL TRANSDUCER EVALUATION

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An underwater piezoelectric directional transducer prototype, to be used in underwater acoustic networks, combines different vibration modes of a cylinder to synthesize desired beam patterns. Performance is evaluated in an anechoic water tank, with reference hydrophones and a signal analyzer capable of Fast Fourier Transform (FFT) data processing. An impulse technique is used for measuring impedance, admittance, Transmitted Voltage Response (TVR), Receiving Voltage Sensitivity (RVS), and horizontal and vertical beam patterns. In this technique, a single-cycle tone burst is emitted at a low frequency repetition rate and excites the driving transducer. The signal analyzer excludes the acoustic reverberations from the tank walls by adequate adjusting of the FFT sampling window. Additionally, for beam-pattern data acquisition, a computer simultaneously samples the azimuthal orientation of the prototype relative to a reference hydrophone and the corresponding frequency response, as the evaluated transducer continuously rotates. The FFT capability of the signal analyzer also supports intrinsic noise evaluation. The results show that the new transducer architecture is capable of producing directional beam patterns according to the present operational requirements by electronic control of the internal electrode applied voltage distribution.

KEYWORDS: Underwater Acoustics, Underwater Communication, Acoustic Modems, Directional Underwater Transducers, Piezoelectric Transducers, Acoustic Measurements, FFT Data Processing

MASTER OF SCIENCE IN ENGINEERING SCIENCE

COMPUTATIONAL FLUID DYNAMICS ANALYSIS OF SHOCK PROPAGATION AND REFLECTION IN A PULSE DETONATION ENGINE COMBUSTOR

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The ability to enhance detonation wave transmission at a diffraction plane through various shock reflection/focusing conditions was evaluated numerically. The geometry dimensions were generally representative of the condition existing in a valve-less pulse detonation engine developed by the Naval Postgraduate School, and consisted of a small cylindrical "initiator" combustor, which transmitted a shock wave to a larger diameter combustor. The wall cross section of the larger combustor was varied to evaluate the increase in reflected shock temperature and pressure conditions, ultimately revealing the dramatic increase in local temperature for a "scalloped" outer wall condition over the cylindrical cross section cases. The initiator diameter was held constant and the larger combustor diameters varied in order to evaluate the effects of diameter ratio on the shock reflection conditions for both cylindrical and scalloped geometries. A computational fluid dynamics (CFD) solver known as OVERFLOW was used to model the fluid dynamic processes, but was limited in capability to shock wave Mach numbers less than about 4.2.

KEYWORDS: Pulse Detonation Engine, PDE, Combustion, Detonation, Computational Fluid Dynamic, CDF, Overflow, Shock Reflection, Shock Focusing

NUMERICAL ANALYSIS OF THE PERFORMANCE OF STAGGERED PIN-FIN MICRO HEAT EXCHANGERS

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The heat transfer and pressure drop characteristics of a staggered micro pin-fin heat exchanger were analyzed using a three dimensional finite element based numerical model. Simulations were conducted based on low Reynolds number, fully developed laminar airflow through an array of circular pin-fins. A range of results was obtained from different configurations with varying pin spacing, axial pitch, and pin height. The results from this study would be useful in ongoing work on the design of a laminar flow micro heat exchanger for high heat flux dissipation systems.

KEYWORDS: Numerical Analysis Heat Transfer, Micro Pin-Fin Heat Exchanger, Turbine Blade Cooling, Electronic Component Cooling

NUMERICAL STUDY OF THE EFFECT OF THE FUEL FILM ON HEAT TRANSFER IN A ROCKET ENGINE COMBUSTION CHAMBER

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The combustion chamber of a liquid-fueled rocket engine with an injected fuel film on the wall has been numerically simulated. The engine has been modeled to operate on a RP-1/gaseous oxygen mixture at a chamber pressure of 35 atmospheres. The fuel is a hydrocarbon blend and is used for both engine operation and the fuel-film layer. The fuel layer acts as a flowing thermal insulating shield, reducing the amount of convective and radiative heat flux from the hot combustion gases to the chamber wall. This effort evaluates the effectiveness of the fuel layer in achieving a reduced heat flux to the chamber wall under varying emission/absorption conditions. The tendency of hydrocarbon fuels to produce soot precipitates at near 550K directly affects the optical properties of the fuel layer, and the resulting heat transfer to the wall has been modeled and discussed.

KEYWORDS: Heat Transfer, Rocket Engine, Combustion Chamber, Film Cooling, RP-1, Absorption Coefficient, RADCAL, TEP, CFDACE

COLD FLOW DRAG MEASUREMENT AND NUMERICAL PERFORMANCE PREDICTION OF A MINIATURE RAMJET AT MACH 4

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Second Reader: Raymond P. Shreeve, Department of Mechanical and Astronautical Engineering

Experimentation was carried out in a supersonic wind tunnel to investigate the drag force on a miniature ramjet when subjected to Mach 4 flow. CFDRC-FASTRAN, a numerical flow solver developed for the analysis of high-speed flows, was used to model the performance of the miniature ramjet. To reduce computational time, a 2D axisymmetric model of the ramjet was developed to investigate the shock angles over the intake and the results were compared with the experiment. A 3D axisymmetric flow model was developed to investigate the fuel mixing which was injected into the ramjet from the nose cone and from the struts, which held the centerbody in place. Finally, a 2D model was developed to investigate the combustion of the propane fuel, which was injected from the struts. For all of the simulations, a two-equation, $k-\omega$, turbulence model was used. Further investigation is needed at supersonic freestream conditions in the simulation of the combustion process.

KEYWORDS: Ramjet, Drag Measurement, Mach 4, Turbulence Modeling, Simulation

BROADBAND COUNTERWOUND SPIRAL ANTENNA FOR SUBSURFACE RADAR APPLICATIONS

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Subsurface radar, also known as ground penetrating radar, is increasingly being used to detect and locate buried objects such as mines and structures that are found within the upper regions of the earth's surface. This thesis reviews the work done to date in this area, laying emphasis on possible antenna designs to match the range of intended applications. An overall design strategy is outlined, together with a more detailed treatment of the ground penetrating radar subsystems and topics that are relevant to effective

subsurface radar operation. These include the dielectric properties of earth materials, the choice of frequency of operation, as well as the design and construction of suitable antennas.

Finally, a new antenna structure called the counter-wound spiral antenna, which is suitable for subsurface radar applications, is examined. The counter-wound spiral antenna has a broad bandwidth and a linear polarization with a controllable plane of polarization from a planar geometry. It has an electronically steerable plane of polarization. This unique property offers a reduction in antenna polarization loss and allows the extraction of maximum information from the target scattered echo.

KEYWORDS: Subsurface Radar, Ground Penetrating Radar System, Frequency Independence Antenna, Spiral Antennas, Ground Dielectric Properties

VULNERABILITY OF WIRELESS POINT-TO-POINT SYSTEMS TO INTERCEPTION

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Wireless systems have always been susceptible to interception in both urban and indoor environments. In point-to-point communication links, the placement of base station antennas is usually determined by an experimental or analytical assessment of the propagation path. Since point-to-point links are typically used to network widely separated areas, antennas used in such situations are likely to be directional, but may still be susceptible to interception by covert entities.

In this thesis research, issues pertaining to vulnerability will be identified and preventive measures will be suggested. The generation of received signal contours as a function of location and frequency for different propagation models will also be investigated. This thesis thus examines the vulnerabilities of wireless point-to-point communication to interception by propagation simulations using computational electromagnetic codes available in the Naval Postgraduate ECE Department's Microwave and Antenna Laboratory. The software developed was used to examine the vulnerability of these wireless systems and identify simple measures that can be taken to increase the system's security.

KEYWORDS: Wireless Point-to-Point Systems, Urbana Wireless Toolset, Cifer, Xcell, Signal Contours, Antenna Rotation, Wireless Vulnerability, Interception

MODELING OF THE RING-HYBRID DIPOLE ANTENNA AND MUTUAL COUPLING IN A SMALL ANTENNA ARRAY

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This thesis project modeled a microstrip ring-hybrid dipole that is capable of simultaneously producing a sum pattern and difference pattern using the method of moments (MoM) based on the Rao-Wilton-Glisson (RWG) edge elements. The ring-hybrid dipole is simply a ring-hybrid coupler driving a dipole antenna. A two-feed point dipole model was developed and its antenna parameters were found to be a good representation of the ring-hybrid dipole actual values. In the feed network modeling, the matrix solution combined the MoM equations on the antenna surfaces and a magic-tee scattering matrix by applying Kirchhoff's voltage and current laws at the terminals of the antenna. Once the excitation is specified, the complete system of equations was solved to yield the MoM current expansion coefficients and the signals in the feed network.

The effect of mutual coupling in an array of three ring-hybrid dipoles was examined by extending the model. In the receive mode, the direction and polarization of the incidence plane wave were varied. The phases for both the sum port and difference port outputs were observed to change smoothly, except during

situations of cross-polarization and zero phase difference. The array model will form the foundation for the design and analysis of a mutual coupling compensation network.

KEYWORDS: Method of Moments, RWG Basis Function, Scattering and Radiation, MATLAB, Dipole Antenna, Antenna Feed Network, Scattering Parameters, Transmission Line, Magic-Tee, Ring Hybrid, Phased Array Antenna, Mutual Coupling

DIGITAL ANTENNA ARCHITECTURES USING COMMERCIAL-OFF-THE-SHELF HARDWARE

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Master of Science in Engineering Science (Electrical Engineering)-December 2003

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Second Reader: Roberto Cristi, Department of Electrical and Computer Engineering

Changes in warfighting tactics and advancement of technology shape ways to implement and design multifunction phased array radars. This thesis investigated whether the commercial modulation boards used in the 3-D 2.4-GHz phased array transmit antenna are capable of wideband performance. The phase of the transmitted signal out of the modulator board was adjusted to provide a phase shift from 0 to 2π , and the insertion phases at these phase settings were measured using a Vector Network Analyzer, sweeping the frequency from 0.8 to 2.5 GHz. The measured insertion phases are used to simulate the radiation pattern of a linear phased array, and the results show that modulator does not have instantaneous wideband characteristics.

This thesis also looked at the design of the complementary phased array receiver architecture using commercially available demodulator boards. The demodulator board was successfully configured to operate as a phase shifter. Phase shifted transmit signals were injected into the demodulator, and corresponding phase shifts were measured via the *In-Phase* and *Quadrature* voltages.

KEYWORDS: Phased Array, Array Bandwidth, Beamforming, Radar, Antenna, Transmitter, Receiver, Direction Finding, Modulation, Demodulation, COTS

BISTATIC RADAR SYSTEM ANALYSIS AND SOFTWARE DEVELOPMENT

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Second Reader: Curtis Schleher, Department of Information Sciences

Bistatic radar has some properties that are distinctly different from monostatic radar. Recently, bistatic radar has received attention for its potential to detect stealth targets due to enhanced target forward scatter. Furthermore, the feasibility of hitchhiker radar has been demonstrated, which allows passive radar receivers to detect and track targets. This thesis developed a software simulation package in MATLAB that provides a convenient tool to examine the bistatic radar design parameters and predict system performance. The software model is suitable for instructional purposes due to its user-friendly graphical user interface. Several bistatic radar applications were used to illustrate the software features, and their results were analyzed and discussed.

KEYWORDS: Bistatic Radar, Multistatic Radar, Oval of Cassini, Performance Prediction, Computer Simulation, Graphical User Interface

MASTER OF SCIENCE IN INFORMATION SYSTEMS AND OPERATIONS

MILITARY-MEDIA RELATIONSHIPS: ANALYZING U.S. NAVY OFFICERS' ATTITUDES TOWARDS THE NEWS MEDIA

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Master of Science in Information Systems and Operations-December 2003

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Second Reader: Karen Guttieri, Department of National Security Affairs

A noticeable civil-military gap has emerged in American society, where the public does not fully understand the mission of the military and the military does not understand the expectations and demands of the public in a liberal democracy. Basically, maintaining a good rapport with the media is vital to bridge this "civil-military gap." Military cooperation with the media, by allowing appropriate access, enables journalists to communicate with the military base of support in the public, and thus may prove vital to effective military operations. As a result, the public will be better prepared to embrace "good news" stories that are introduced by the military and also prepared to accept the times when a negative story breaks in the news.

From an online survey administered to the unrestricted line (URL) community of Navy officers, this research identifies instances of Navy officer bias that is derived from family background, limited interaction and experience in working with the media, and inherently from bias that is subordinated from senior naval leadership. Based on these findings, the author believes that the U.S. Navy may not continue to mold individuals to think in new and innovative ways for future naval missions unless they are given a much broader and more thorough roadmap of critical thinking and analytical skills, which invariably includes the consideration of military-media relationships when planning and executing military operations.

KEYWORDS: Military-Media Relationships, Bias, Public Affairs, Civil-Military Relations, Civil-Military Operations, Information Operations, IO, CMO, Civil Affairs, CA

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

THE EFFECTS OF CHINA ENTERING THE WORLD TRADE ORGANIZATION ON THE UNITED STATES' WIRELESS TELECOMMUNICATION INDUSTRY

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Master of Science in Information Technology Management-December 2003

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This thesis investigates the effects of China entering the World Trade Organization on the United States' wireless telecommunication industry. This thesis explores whether the American wireless telecom industry will benefit from China's accession into the WTO. The working hypothesis of the thesis is that American wireless telecom companies will receive far-reaching economic benefit from China's entry into the WTO. Additionally, this thesis explores the effects the entry in the WTO will have on China's telecom policy toward allowing foreign companies to own and operate parts of the wireless telecom network.

KEYWORDS: People's Republic of China, Wireless, Telecom, United States, 3G, CDMA, GSM, TD-SCDMA, China Mobile, China Unicom, China Telecom, China Netcom, MII, Telecommunications, China, WTO, World Trade Organization, Personal Access System, BREW

FORCENET ENGAGEMENT PACKS: "OPERATIONALIZING" FORCENET TO DELIVER TOMORROW'S NAVAL NETWORK-CENTRIC COMBAT REACH CAPABILITIES TODAY

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In response to the CNO's tasking to examine *Sea Supremacy* within the context of SEA POWER 21, SSG XXII proposed the concept of FORCENet Engagement Packs (FnEPs). The FnEPs concept represents the operational construct for FORCENet and demonstrates the power of FORCENet by integrating a specific set of joint sensors, platforms, weapons, warriors, networks, and command and control systems, for the purpose of performing mission-specific engagements. Initial pack asset allocation and constitution will be based on a specific threat or mission; however, the capability to dynamically re-configure and re-allocate assets "on the fly," to reconstitute a new pack, will enable cross-mission engagement capabilities. Integrating the six FORCENet factors must focus on five critical functions termed "Combat Reach Capabilities (CRCs)." These include: Integrated Fire Control (IFC), Automated Battle Management Aids (ABMAs), Composite Tracking (CT), Composite Combat Identification (CCID), and Common/Single Integrated Pictures (CP). FnEPs achieves fully integrated joint capabilities focused on the engagement chain, and represents a revolutionary transformation in Naval operations complimentary to FORCENet, SEA POWER 21, and *Sea Supremacy*.

This thesis has two goals. First, an analysis is conducted to better understand the FnEPs concept, including the myriad of technical, organizational, and programmatic requirements for its implementation. Second, a roadmap is proposed for the continued development and "institutionalization" of the FnEPs concept.

INFORMATION TECHNOLOGY MANAGEMENT

KEYWORDS: C², C⁴ISR, Command and Control, Engagement Chain, FnEPs, FORCEnet, FORCEnet Engagement Packs, NCW, Network-Centric Warfare, SEA POWER 21, *Sea Supremacy*, SSG, SSG XXI, SSG XXII, Strategic Studies Group

A SURVEY AND SECURITY STRENGTH CLASSIFICATION OF PKI CERTIFICATE REVOCATION MANAGEMENT IMPLEMENTATIONS

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Second Reader: Daniel F. Warren, Department of Computer Science

In this thesis, all currently operational, proposed, and theoretically possible methods of certificate revocation are defined. The role of certificate revocation within the larger scheme of PKI is examined and the mandates upon the Department of Defense from the Certification Practices Statement (CPS) and Certificate Policy (CP) are examined. A "best case" model for revocation is suggested. The security attributes affecting certificate revocation are examined: from these attributes a set of metrics are defined for the purpose of measuring the security-relevant strengths and weaknesses of all plausible methods of certificate revocation. Each method is examined and ranked according to security strength. Conclusions regarding certificate revocation use within the Department of Defense are made and further study within the field is suggested.

KEYWORDS: PKI, X.509, OSCP, NOVOMODO, SCVP, CRL, Certificate Revocation, Security, DoD, Certificate Policy, Certification Practices Statement

REENGINEERING HUMAN PERFORMANCE AND FATIGUE RESEARCH THROUGH USE OF PHYSIOLOGICAL MONITORING DEVICES, WEB-BASED AND MOBILE DEVICE DATA COLLECTION METHODS, AND INTEGRATED DATA STORAGE TECHNIQUES

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In the field of human research, particularly in operational environments, data collection techniques are difficult. Researchers often focus their efforts on the data analysis and overlook the shortcomings of their data collection and storage methodologies. In order to demonstrate effective data collection and storage methodology in a representative human research process, the process used by human fatigue and performance researchers at the Human Systems Integration Lab at the Naval Postgraduate School (NPS) served as a Proof of Concept for this thesis. Most recent studies conducted at NPS provided a model of the current process. The Knowledge Value Added (KVA) methodology was used as a tool of comparison of the current process to the reengineered process. Information technologies, including wireless physiological monitoring devices, web-based and mobile device data collection methods, and integrated data storage techniques, were incorporated in the reengineering effort. The data storage process included the design of a standard relational database format allowing research teams to easily access their data. This repository also enables data to be archived for future use (e.g., meta-analyses). To demonstrate the reengineered process in an operational environment, a field fatigue study was conducted at the Naval Officer Indoctrination School (OIS) in Newport, Rhode Island.

KEYWORDS: Data Collection Methodology, Mobile Devices, Relational Database, Human Performance, Sleep, Fatigue, Sleep Deprivation, Actigraphy, ARES

MASTER OF SCIENCE IN LEADERSHIP AND HUMAN RESOURCE DEVELOPMENT

A COST-BENEFIT ANALYSIS OF EARLY GRADUATE EDUCATION PROGRAMS FOR U.S. NAVAL ACADEMY GRADUATES

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This thesis examined the effects of participation in early graduate education programs on retention among 1988-1996 United States Naval Academy (USNA) graduates. The comparison group of non-participants consisted of USNA graduates in the top 200 on the Order of Merit in order to make the academic background similar to participants. The retention behavior of program participants and non-participants was compared to determine if granting early graduate education had an effect on retention to six years of service (one year beyond the minimum required service). For a pooled sample of all graduates, both the Voluntary Graduate Education Program (VGEP) and Scholarship program had positive effects on retention. The cost-benefit analysis found positive net benefits for VGEP, but a net-loss for the Scholarship program. However, while the analysis includes all costs, it omits some of the non-quantifiable benefits of the programs. If these benefits were quantified and included, it is expected that both programs would yield positive net benefits. Minor changes to the additional service requirements for both programs were recommended.

KEYWORDS: VGEP, Scholarship, Graduate Education, Logit, USNA, Order of Merit, Minimum Service Requirement, Cost-Benefit Analysis

MASTER OF SCIENCE IN MANAGEMENT

ESTABLISHING THE ROLE, FUNCTIONS, AND IMPORTANCE OF PROGRAM MANAGERS AND PROGRAM MANAGEMENT TEAMS IN THE AFP MODERNIZATION PROGRAM ACQUISITION PROCESS: A COMPARATIVE ANALYSIS WITH U.S. DOD SYSTEM

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Master of Business Administration-March 2003

Master of Science in Management-March 2003

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This research describes the Acquisition Process of the Armed Forces of the Philippines (AFP) Modernization Program, particularly the role, functions, and importance of Program Managers (PM) and Program Management Teams (PMT) in the overall process. The Modernization Program, including acquisition processes for new systems, is a new experience for the AFP. Apparently, the organization intends to optimize the acquisition process for new systems by ensuring an effective and accountable organization structure that would sustain AFP modernization efforts and capabilities.

Presently, PMs and PMTs are temporary in the organizational structure and have no concretely delineated role in the acquisition process. Their function and responsibilities are limited to the AFP Major Service requirement generation process.

Likewise, this research will introduce the U.S. DoD acquisition system and illustrate the DoD PMs' and Integrated Project Team's (IPT) roles and functions in defense programs. The paper will show the importance of the PM and IPTs to the overall life cycle of any system. By comparative analysis, the research will reveal limitations in the AFP approach. The U.S. acquisition model, relative to PMs and PMTs, will be useful for improving the AFP process. After all, the U.S. has proven itself relatively successful in acquisition projects.

KEYWORDS: Program Managers, PM, Program Management Teams, PMT, IPT

MASTER OF SCIENCE IN MECHANICAL ENGINEERING

PRELIMINARY DESIGN STUDY OF AN ENHANCED MIXING EDUCTOR SYSTEM FOR THE LANDING, HELICOPTER ASSAULT SHIP REPLACEMENT GAS TURBINE EXHAUST

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Master of Science in Mechanical Engineering-December 2003

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A preliminary design study was conducted to determine the geometry for an enhanced mixing eductor system for the Landing, Helicopter Assault Ship Replacement (LHA (R)) program gas turbine exhaust. A one-dimensional analytical model, with a correction factor applied to the secondary mass flow, was developed to predict the secondary air mass flow rate and the exhaust temperature at the mixing tube exit plane. The resultant design consisted of a high aspect ratio lobed nozzle and a mixing tube. The model was also used to predict the backpressure developed by the ducting configuration. The proposed design resulted in a 50% reduction in exhaust temperature with only a six inch H₂O increase in backpressure. A detailed design of the oval-to-rectangular transition duct is provided, based on empirical data from a similar duct design. The study also included a prediction of plume radiation intensity in the 3-5 μ m band for various aspect ratio slots.

KEYWORDS: Eductor, Enhanced Mixing, Lobed Mixer, Gas Turbine Exhaust, Plume Radiation

WAVE MAKING RESISTANCE CHARACTERISTICS OF TRIMARAN HULLS

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Master of Science in Mechanical Engineering-December 2003

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Recently, there has been an increased demand for high-speed vessels for both military and commercial applications. Many navies are exploring the potential of novel hull forms as part of efforts to achieve transformation in both combat and logistics missions in littoral seas. This demand for high-speed vessels has resulted in a need for unconventional hull forms in order to balance speed with payload requirements. One such hull form is the trimaran. The purpose of this thesis is to investigate the effects of side hull position on the wave making resistance characteristics of powered trimarans. Resistance calculations were performed by a three dimensional, Rankine panel code. A systematic series of runs was conducted in order to classify ship resistance in terms of major trimaran hull geometric configurations. The results of this thesis can be directly utilized in design, in order to minimize ship resistance and maximize available payload.

KEYWORDS: High-Speed Vessels, Littoral, Unconventional Hull Forms, Side Hull, Trimaran, Rankine Panel Code, Resistance, Payload

MECHANICAL ENGINEERING

SENSITIVITY ANALYSIS OF THE SEAKEEPING BEHAVIOR OF TRIMARAN SHIPS

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The dynamic response of the ship while operating in different sea conditions is one of the design parameters of a hull form. The objective of this thesis is to analyze the seakeeping response of trimaran hulls. A three-dimensional Rankine source panel method is used to achieve that. Seakeeping response characteristics of a typical trimaran with a variable separation ratio (the ratio of the lateral distance between center hull and side hull to the length of the ship) and with different longitudinal positions of the side hulls are analyzed. Heave and pitch motion response amplitude operators are evaluated for bow, bow quartering, and beam waves in irregular seas at various ship forward speeds. The corresponding heave and pitch responses were calculated by applying the Bretschneider spectral formulation. Seakeeping behaviors of the generic trimaran are classified based on the plots of root mean square values for every position of the side hulls at different sea states to determine optimal location of the side hulls with regard to seakeeping.

KEYWORDS: Seakeeping, Ship Response Spectrum, Trimaran Hull Form, SWAN2, Root Mean Square, Response Amplitude Operator

MOLECULAR DYNAMICS SIMULATION OF FATIGUE DAMAGE IN METALS

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Molecular dynamics simulation was conducted to better understand the mechanism of fatigue failure and to identify a parameter(s) that can indicate progressive damage due to cyclic loading. The Embedded Atom Method (EAM) was used for copper atoms subjected to cyclic loadings. Defective crystal structures including vacancies or impurities were considered for the study. The results showed that there was an increase in potential energy and kinetic energy, respectively, in the metal as the number of cycles increased. This means the metal becomes weaker, i.e., an indication of progressive damage. Therefore, the change of potential energy may be used as an indicator for fatigue damage accumulation. Furthermore, the relative distances between vacancies (or impurities) increased globally with fluctuation as the number of loading-unloading cycles increased.

KEYWORDS: Metals, Fracture, Mechanical Properties

FIN STABILIZERS AS MANEUVER CONTROL SURFACES

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Roll angle is often a limiting factor during high-speed turns and repetitive turning maneuvers. Navy and Coast Guard surface ships are designed for high-speed operation. Sharper turns at higher speeds and repetitive high-speed turns can increase ship survivability by helping these vessels avoid incoming threats. This is particularly true if the amount and direction of roll during the turn is controlled, since the ship's susceptibility to radar and other sensors may be diminished at certain angles. Sharper turns at higher speeds can also reduce the time it takes to reach a person in the water, improving the chances for successful rescue. Controlled roll during repetitive sharp turns can make high-speed pursuit safer and more likely to succeed. The objective of this thesis is to study the effects of fin stabilizers on a ship's turning

MECHANICAL ENGINEERING

performance. Fin stabilizers, commonly added to a ship design for the sole purpose of minimizing unwanted roll during ordinary operations, are also shown to favorably influence both the magnitude and direction of heel experienced during high speed and repetitive maneuvers. The effects of fin stabilizers on other turn performance characteristics are also examined. A strategy for actively employing fins during maneuvers is proposed.

KEYWORDS: Surface Ship, Fin Stabilizers, Maneuver, Roll, Turning

AN EMPIRICAL STUDY OF A PIN-FIN HEAT EXCHANGER IN LAMINAR AND TURBULENT FLOW

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This study concentrates on the empirical characterization of a staggered array pin-fin compact heat exchanger placed in a modular, rectangular wind tunnel. A full analysis of the heat transfer and pressure drop behavior was conducted on various pin-fin shapes, sizes, and configurations. The study was based on airflow over a range of low Reynolds numbers in the laminar and low turbulent flow, as well as higher turbulent flow regimes. The empirical data gathered can be used to corroborate and develop better numerical models to characterize the performance of such compact heat exchangers.

KEYWORDS: Compact Heat Exchanger, Experimental Study, Pin-Fin Array

HORIZONTAL STEERING CONTROL IN DOCKING THE *ARIES* AUV

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To keep the operational cost down and increase the mission time with minimum human intervention, autonomous recovery or docking operation of an Autonomous Underwater Vehicle (AUV) is required. Central to the successful autonomous docking process of the AUV is the capability of the AUV to track and steer itself accurately towards the dock, which is constantly perturbed by wave motion effects. In addition, for accurate acoustic homing during the final stages of the docking, the AUV requires acoustic systems with high update rates. Equipped with acoustic modem, *ARIES* had experimentally been tested to have an update rate of only about 0.3 Hz. These delayed data can potentially cause a false commanded reference input to the tracking system in between the updates and cause *ARIES* to miss the moving cage's entrance.

This thesis attempts to investigate the effectiveness of the use of cross track error and line-of-sight error sliding mode controller coupled with dynamic waypoints allocation in horizontal steering of *ARIES* in docking operations. In the absence of cage heading updates, a predictive method based on angular rate and direction of motion was used to estimate the dynamics of the moving cage. Further analysis was performed in order to understand the limitations of such an implementation.

KEYWORDS: Sliding Mode Control, Waypoint Navigation, Docking of AUV

MECHANICAL ENGINEERING

EXPERIMENTAL AND NUMERICAL ANALYSIS OF A CROSSFLOWFAN

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An auto vehicle that can take off and land vertically is envisioned to solve current and future problems of road congestion by utilizing the enormous air space above us. In the past, a crossflow fan was considered to serve this purpose, but its capability is not sufficient to provide enough vertical thrust with limited power and space. Hence, more in depth study is required to further improve the thrust efficiency and thrust to power ratio to a point where this thrust producing method is viable.

A 12-inch diameter, 1.5-inch span, 30-blade crossflow fan test apparatus was constructed and tested using an existing Turbine Test Rig as a power source. Instrumentation was installed and a data acquisition program was developed to measure the performance of the crossflow fan. Performance measurement was taken over a speed range of 1,000 to 6,000 RPM.

An experiment was conducted with the crossflow fan to determine, among other things, the stalling characteristics of the compressor. Performance and flow visualization results were compared to predictions obtained from a 2-D numerical simulation conducted using Flo++, a commercial PC-based computational fluid dynamics software package by Softflo.

KEYWORDS: Crossflow Fan, VTOL, Experiment, Numerical Simulation

MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY

USING RAPID ENVIRONMENTAL ASSESSMENT TO IMPROVE THE HAZARD PREDICTION AND ASSESSMENT CAPABILITY FOR WEAPONS OF MASS DESTRUCTION

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Master of Science in Meteorology and Physical Oceanography-December 2003

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The Oceanographer of the Navy is responsible for the environmental data portion of the "4-D cube." This is a new concept that creates a Virtual Natural Environment that must be capable of rapid environmental updates. This research investigates using in situ atmospheric measurements to improve the performance of the Navy mesoscale model, Coupled Ocean-Atmosphere Mesoscale Prediction System. These enhanced, operational model forecasts are used to supply atmospheric forcing to a dispersion model, the Hazard Prediction and Assessment Capability, and the outcome is evaluated to determine the impact of the additional data.

KEYWORDS: REA, TEDServices, Dispersion Model, Mesoscale Model, COAMPS-OS, VNE, JEM, HPAC

MASTER OF SCIENCE IN MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

RENDERING LARGE-SCALE TERRAIN MODELS AND POSITIONING OBJECTS IN RELATION TO 3D TERRAIN

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Master of Science in Modeling, Virtual Environments, and Simulation-December 2003

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In this thesis, a method is presented for rendering 3D terrain and placing objects on that terrain. The terrain is based on Digital Terrain Elevation Data (DTED) and represents real world terrain. The terrain is built relative to an ellipsoid based model of the earth and is therefore accurately displayed with curvature of the earth. Objects are then placed on the terrain with the proper elevation determined by the terrain objects themselves along with the proper orientation. Using these constructs, users can build terrain models of places all over the earth and move objects on that terrain with minimal effort. A final benefit is that all of the constructs built in this thesis are based upon open standards in the Virtual Reality Modeling Language, Extensible 3D Graphics, and Java. Thus, the code in this thesis can be used by anyone without acquiring any licenses.

KEYWORDS: Virtual Reality Modeling Language, VRML, GeoVRML, X3D, Extensible 3D Graphics, Terrain, Digital Terrain Elevation Data, DTED

THE EXTENSIBLE RUN-TIME INFRASTRUCTURE (XRTI): AN EXPERIMENTAL IMPLEMENTATION OF PROPOSED IMPROVEMENTS TO THE HIGH LEVEL ARCHITECTURE

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The establishment of a large-scale network of persistent shared virtual worlds depends on the presence of a robust standard for communicating state information between the applications that host and provide access to those worlds. The High Level Architecture (HLA) can serve as the basis for such a standard, but not before several of its shortcomings are resolved. First, it must be made easier to use. Second, it must specify a standardized message protocol. Third, it must support dynamic object model extension and composition. Finally, its authors must provide an open-source, freely redistributable run-time infrastructure.

This thesis documents the creation of the Extensible Run-Time Infrastructure (XRTI), an experimental platform that addresses the above requirements while retaining full backwards compatibility with the existing HLA standard. To increase ease-of-use, the XRTI provides a proxy compiler that generates customized sets of Java™ source files based on the contents of arbitrary Federation Object Model Document Data (FDDs). To encourage message protocol standardization, the XRTI uses a novel bootstrapping methodology to define its low-level interactions in terms of an HLA object model. The XRTI supports the dynamic composition and extension of such object models through its Reflection Object Model (ROM), and this thesis demonstrates that ability by depicting the integration of the XRTI into NPSNET-V, a dynamically extensible platform for virtual environment applications.

MODELING, VIRTUAL ENVIRONMENTS, AND SIMULATION

KEYWORDS: High Level Architecture, HLA, Run-Time Infrastructure, RTI, NPSNET, Networked Virtual Environments, Network Protocols, Middleware, Open-Source, Java, Dynamic Extensibility, Code Generation, Interoperability, Distributed Simulation

CREATING DIGITAL ENVIRONMENTS FOR MULTI-AGENT SIMULATION

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There are few tools available for military and civilian simulation developers to quickly and efficiently develop high-fidelity digital environments capable of supporting high-resolution, agent-based simulation. In this work, the author has tried to lay a solid foundation for further understanding the digital terrain support available to simulation developers.

This thesis explores numerous digital terrain data representations and tools available to create digital environments. The work explores the specific problem of terrain database generation for agent-based ground combat simulation. To accomplish this, the author explores the more general problem of where to find the data, what tools are available, and how to put the pieces together to create a registered digital environment on a state-of-the-art computer. The author envisions this methodology to be the first step in the design of an automated planning tool capable of importing real world digital terrain data and quickly generating agent-based military combat scenarios for any location on earth.

This work provides a logical construct and design methodology for an analyst to create high fidelity terrain data sets. It functions as a "how to" manual to help analysts understand which information and tools are available to use for different types of simulation projects.

KEYWORDS: Synthetic Natural Environment, Terrain Data Representation, Terrain Data Format, Agent-Based Modeling, Multi-Agent Systems, Complex Adaptive Systems

MASTER OF SCIENCE IN OPERATIONS RESEARCH

ESTIMATING INTER-DEPLOYMENT TRAINING CYCLE PERFORMANCES

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Master of Science in Operations Research-December 2003

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Second Reader: Robert A. Koyak, Department of Operations Research

The objective of this thesis is to estimate Inter-Deployment Training Cycle (IDTC) performances of the U.S. Pacific Fleet surface ships, which are evaluated at the end of the Basic Training Phase, by using Command Metrics Tool (COMET) metrics. The basic objective was primarily to decide whether the COMET database can be used to estimate performances of ships, and to build regression models to estimate Final Evaluation Problem (FEP) performances of ships.

This study develops multivariate logit regression models to examine and explore the structure of the data sets. Most of the models developed according to statistical criteria include only the intercept, indicating that there is no real relationship between the COMET metrics and IDTC performances. The assessments made at the end of FEP are not good Measure of Performances (MOPs) by which to assess ships' IDTC performances.

KEYWORDS: Inter-Deployment Training Cycle, Final Evaluation Problem, Command Metrics Tool, COMET, Logistic Regression

ANALYSIS OF STRYKER BRIGADE COMBAT TEAM STRATEGIC SEALIFT DEPLOYMENT OPTIONS

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Master of Science in Operations Research-December 2003

Advisor: LTC Eugene P. Paulo, USA, Department of Operations Research

Second Reader: CDR Kevin J. Maher, USN, Department of Operations Research

Projecting a credible land combat power to a potential conflict area in a timely manner requires rapid strategic sealift mobility with high capacity. A highly deployable, light, yet sufficiently lethal force capable of deterrence or sustaining combat is necessary to accomplish this objective.

The Army's initial steps towards transformation seek to establish that ability. This transformation requires having lighter forces with quicker deployment times, thereby turning the Army from the Legacy Force, made up of both well-equipped heavy war fighting forces, which are difficult to deploy strategically, and rapidly responding light forces, which lack staying power against heavy mechanized forces, into an Interim Force of Stryker Brigade Combat Teams (SBCT). The SBCT combines the capacity for rapid deployment with survivability and tactical mobility. The Army's objective is to deploy the Stryker Brigade Combat Team, a brigade-sized force equipped with medium weight armored vehicles, anywhere in the world within 96 hours (Vick, 2002).

This thesis determines the mix of sealift assets best suited for different scenarios that differ by distance and port accessibility, and analyzes the implications of these findings on Army deployment doctrine. This is accomplished in two ways. First, two specific scenarios are used to develop the initial requirements and best mix of assets for SBCT deployment based on a fictional Kosovo campaign. Additionally, a preliminary analysis is conducted of the three feasible configuration options. The options are: (1) TSVs only, (2) LMSRs only, or (3) a combination of the two. These three options are compared using fixed cargo requirements and their performance versus cost is analyzed based on the Kosovo campaign distances.

KEYWORDS: Stryker, Sealift, Stryker Brigade Combat Teams, SBCT, Rapid Deployment

OPERATIONS RESEARCH

ANALYSIS OF EFFECTIVENESS OF COOPERATIVE ENGAGEMENT CAPABILITY USING SCHUTZER'S C² THEORY

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Master of Science in Operations Research-December 2003

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Jae Yeong Lee, National Defense University of Republic of Korea

Second Reader: LCDR Russell Gottfried, USN, Department of Operations Research

Information superiority can be obtained by enhancement of the command and control system. While weapon systems may have been developed to a point of decreasing returns regarding firepower, command and control (C²) systems can be developed further. The force that has superior C² may win the fight in the future by information superiority.

Currently, there is no appropriate methodology to assess the contribution from the C² system to improved combat outcomes. This thesis develops a methodology to address Cooperative Engagement Capability (CEC) by modifying the C² theory developed by D.M. Schutzer. The author addresses the time line that Schutzer suggested as the key to addressing C² improvements concretely and modifies the MOE he designed. Based on this modified MOE, developed through simulation analysis of an air defense scenario, the improvement in command and control systems by the CEC system is quantified.

KEYWORDS: CEC, NCW, MOE, C² System, D.M. Schutzer, Simulation, Polynomial Regression, Metamodel, Information Superiority

DEFENSE OF THE SEA BASE – AN ANALYTICAL MODEL

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The purpose of this analysis is to develop an analytical model that describes defense for the Sea Base. Although models have been developed for defense of a carrier battle group (CVBG) with one High Value Unit (HVF) against air, surface, and subsurface attacks, there are unique aspects of the Sea Base that are not specifically addressed in CVBG defense models. First, the defense of the sea base is different in that there are multiple HVFs (Expeditionary Warships – EXWAR Ships) expected in the Sea Base. In addition, there is a credible threat of being overwhelmed by High Density Threats (HDTs) in close proximity to enemy shores, where the enemy need not have a large navy or long range air force to launch an assault. This model specifically addresses the issue of defending multiple HVFs against HDTs.

The model also gives a commander insight into the optimal placement of defenders with respect to parameters such as threat sector, minimum detection range, attacker and defender velocity, and defender weapon ranges. The model can also be used for Operational Requirements (ORs) development by Sea Base system designers. By inputting parameters associated with certain scenarios, system developers can see how performance of a specific parameter, such as weapons range, probability of kill, and radar detection range, can affect the quality of Sea Base defense with respect to the effective area of defender coverage and the number of defenders required to achieve a certain level of protection. Additionally, if given a probability of success requirement for a defender against a certain number of attackers, the model determines the number of shots/salvos which yields that probability and in turn, gives insight into what range of parameters play critical roles in achieving it.

KEYWORDS: Missile Defense, High Density Threat, HDT, Sea Base, Firing Policy, Sector Coverage

OPERATIONS RESEARCH

OPTIMIZING A MILITARY SUPPLY CHAIN IN THE PRESENCE OF RANDOM, NON-STATIONARY DEMANDS

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Second Reader: Robert Dell, Department of Operations Research

Demand for supplies, such as ammunition, during a military operation is a scenario-dependent random variable that may be subject to high variance. The challenge is to design an efficient military logistics supply chain that satisfies uncertain, non-stationary demands, while taking into account the volatility and singularity of military operations. This research focuses on the development of a modeling framework that determines the optimal deployment of transportation assets and supplies at the operational level, with possible interdiction by enemy forces. This model is termed Optimal Military Logistics Supply Chain (OPTiMiLSC). This is a two-level, multiple time period, scenario-based stochastic model. OPTiMiLSC uses a combination of optimization, scenario-based simulation, and statistical analysis. A "scenario tree" method is used to generate the demand scenarios. The results show a positive correlation between the number of demand scenarios and the probability that a random demand scenario is satisfied. OPTiMiLSC is compared with two deterministic optimization approaches. The first approach is where demands are fixed at the 90th percentile, which tends to over-supply when compared to OPTiMiLSC. The mean value approach, on the other hand, tends to under-supply. OPTiMiLSC enables military planners to establish a robust logistic plan that responds more adequately to an intra-theater operation.

KEYWORDS: Military Logistic Supply Chain, Mathematical Programming, Optimization, Simulation, Random and Non-Stationary Demand, Supply, Transportation, Stochastic Programming, Scenarios Tree Generation, Statistic Analysis

AN ENHANCED GRAPHICAL USER INTERFACE FOR ANALYZING THE VULNERABILITY OF ELECTRICAL POWER SYSTEMS TO TERRORIST ATTACKS

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Second Reader: R. Kevin Wood, Department of Operations Research

This thesis develops a Graphical User Interface (GUI) to represent electric power grids subject to interdiction (attack) by terrorists. The work enhances the prototypic One-line Diagram (OD) representations of electric power networks in the VEGA 1.0 decision-support system (Vulnerability of Electrical Power Grids Analysis, version 1.0). Conforming to Windows standards, the new OD GUI incorporates advanced graphical features, which help the user visualize the model and understand the consequences of interdiction. The new ODs also capture the details of system restoration over time following an attack. The enhanced OD GUI has been incorporated into the updated version of the system, VEGA 2.0.

KEYWORDS: Graphical User Interface, Electrical Power Systems, Visual Basic

A MODEL FOR PREDICTING THE REPAIR COSTS OF U.S. NAVY INVENTORY ITEMS

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Master of Science in Operations Research-December 2003

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Second Reader: Lyn R. Whitaker, Department of Operations Research

This research was initiated due to a report claiming that the U.S. Navy significantly overestimated repair prices in a Performance Based Logistics (PBL) reward to a contractor. The purpose of this thesis is to

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develop a model for improving the prediction of repair price for U.S. Navy inventory items. The thesis examines several prediction methodologies, including a ratio-estimator prediction method that is a modification of the methodology currently in use, as well as regression analysis. In contrast to the ratio-estimator approach, regression is able to utilize a wide range of predictor variables, several of which are evaluated in the thesis research. Results of this analysis reveal that a regression model with logarithmic transformations yields more accurate predictions of repair prices than the current methodology. This improvement is seen especially for items that have the highest replacement price. One feature of the proposed regression-based methodology is that predicted repair prices for the most expensive items are substantially lower than with the current methodology. In the case which prompted this thesis research, the overstatement of benefit from the PBL would have been reduced by about 30 million under the proposed methodology.

KEYWORDS: Cost Estimation, Repair Price, Data Analysis, Naval Inventory Items, Operations Research, Regression Analysis

MASTER OF SCIENCE IN PHYSICAL OCEANOGRAPHY

FETCH-LIMITED WIND WAVE GENERATION ON THE CONTINENTAL SHELF

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Master of Science in Physical Oceanography-December 2003

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Second Reader: Edward B. Thornton, Department of Oceanography

The growth of wind waves in coastal areas is limited by the fetch. Understanding this sheltering effect of the coastline on the nearshore wave climate is of critical importance for Navy operations (e.g., amphibious assault and mine countermeasures) in shallow water. Whilst the effect of fetch limitation on the development of the wave field is well understood, the effects of bottom topography, the presence of swell and its interaction with wind waves, the angle of the wind relative to the coastline with regard to the change in effective fetch, and the effects of atmospheric stability, are not well documented. This study investigates fetch-limited wind wave growth by examining cases where a steady wind blows at various angles to a straight coastline, across a continental shelf, in the presence of swell. The observed wind wave growth for offshore winds is consistent with previous observations in the North Sea. The presence of energetic swell opposing the wind does not have a significant effect on the wind sea development. Refraction strongly affects the directional properties of wind waves on the inner shelf. Observed wave growth rates agree well with predictions of the WAVEWATCH III operational wave prediction model forced with COAMPS winds.

KEYWORDS: Wind Waves, Continental Shelf, Fetch

MASTER OF SCIENCE IN PRODUCT DEVELOPMENT

TRANSITIONING ADVANCED CONCEPT TECHNOLOGY DEMONSTRATIONS TO ACQUISITION PROGRAMS

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Master of Science in Product Development-December 2003

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This thesis evaluated the Department of Defense's Advanced Concept Technology Demonstration (ACTD) process and the challenges encountered in transitioning an ACTD to an acquisition program. The methodology included case analyses of two ACTD programs that transitioned to acquisition programs to determine their levels of success. The scope included a review of: 1) ACTD origins and processes as of July 2002, 2) past ACTD programs, 3) the established documentation criteria associated with ACTD selection and evaluation, 4) the two ACTD case programs selected for analysis, 5) the apparent ACTD transition areas prone to success or failure, and 6) potential process improvements that would aid in ACTD transition to acquisition programs. This thesis identified both the strengths and the weaknesses in the existing ACTD transition process. The results indicated that several of the existing ACTD criteria should be maintained. However, it was also determined that several enhancements could be incorporated into future processes. This thesis concluded with recommended improvements that would enhance the insertion of technology to the warfighter via the acquisition process. With the combination of current practices and implementation of these recommendations, ACTDs could become the cornerstone of the Secretary of Defense's new acquisition process.

KEYWORDS: ACTD, Acquisition Reform, JMLS, UGS, Transition, DoD 5000

MASTER OF SCIENCE IN PROGRAM MANAGEMENT

THE DETERMINANTS OF UNITED STATES GOVERNMENT POLICY AND PRACTICE TOWARDS OFFSETS IN INTERNATIONAL TRADE

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Raymond E. Franck, Graduate School of Business and Public Policy

Offsets are countertrade practices through which sellers in exporting countries provide concessions to buying governments as a condition of sale. Offsets are increasing as a percentage of defense exports. Because U.S. industry leads worldwide defense exports, U.S. offsets policy and the potential impact of offsets on U.S. national security are highly significant. U.S. policy considers offsets to be economically inefficient and market distorting, restricts U.S. government agency involvement in offsets and places responsibility for such arrangements with businesses. Offset policy has been the subject of intense and frequently conflicting policy initiatives undertaken between 1973 and 2003, involving both the executive and legislative branches of government. This thesis details why and how U.S. policy on offsets evolved, and identifies key participants and policy decisions. This thesis concludes that, initially, the primary policy drivers were DoD desires to preserve prerogatives to domestically produce foreign designs and to avoid unnecessary friction with allies. DoD led policy development within the executive branch with the publication of offsets policy memoranda by the Deputy Secretary of Defense. While no single focus for congressional offsets policy was identified, a primary policy driver was the perceived loss of jobs resulting from offsets, as legislators from states and districts where organized labor was strong led efforts to mandate restrictions and reporting requirements. Important differences emerged between the legislative and executive branches, regardless of administration, regarding offsets. These included differences regarding the effect of offsets on domestic employment and technology transfer and the appropriate U.S. response to demands for offsets.

KEYWORDS: Offsets, USG Policy, International Trade

MASTER OF SCIENCE IN SOFTWARE ENGINEERING

A METHODOLOGY FOR DEVELOPING TIMING CONSTRAINTS FOR THE BALLISTIC MISSILE DEFENSE SYSTEM

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Master of Science in Systems Technology-December 2003

Master of Science in Software Engineering-December 2003

**Joel D. Babbitt-Captain, United States Army
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Master of Science in Computer Science-March 2004

**Advisors: Man-Tak Shing, Department of Computer Science
J. Bret Michael, Department of Computer Science**

The Department of Defense (DoD) is developing a Ballistic Missile Defense System (BMDS) based on a layered defense that employs complementary sensors, weapons, and C2 elements, integrated by software into a system-of-systems to engage and destroy threat ballistic missiles through all phases of flight. Inherent to the ultimate success of the BMDS will be the timely execution of the kill chain process against threat ballistic missiles.

In this thesis, the Unified Software Development Process (USDP) is applied, utilizing the BMDS as a case study to investigate a means to identify and validate timing behaviors and constraints of system-of-systems. In particular, the information exchange needed for processors to share, collaborate, fuse, and distribute sensor information in a distributed sensor network is examined, and modeling and simulation to provide insight into the timing aspects of interactions among subsystems comprising a system-of-systems is utilized. The case study will involve deriving and documenting system and software requirements, developing a test-ready model for representing the timing requirements, and then validating this model through the use of an OMNET++ simulation. The simulation will then be used to provide feedback to further refine the system requirements and the functional specifications of the subsystems.

KEYWORDS: Software Engineering, System-of-Systems, Ballistic Missile Defense System, BMDS, Sensor Fusion, Collaborative Fusion, Modeling, Simulation, OMNeT++, UML-RT, Real-Time Constraints, Software Requirements, Kill Chain, Timing Requirements, Unified Software Development Process, USDP

MASTER OF SCIENCE IN SYSTEMS ENGINEERING

THEORETICAL AND EXPERIMENTAL STUDY OF MICRO AIR VEHICLE POWERED BY RF SIGNAL AT 10 GHZ

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Micro air vehicles (MAV) belong to a new category of uninhabited air vehicles (UAV), and are several orders of magnitude smaller than the ordinary UAVs. A method of providing power to a MAV using microwaves presents several advantages compared to other types of propulsion, such as minimization or elimination of the power source onboard.

Two prototype MAVs were constructed and tested for power consumption calculations. A rectified array antenna (rectenna) was built, using identical rectifying elements consisting of a patch antenna, Schottky barrier diode, and input and output low pass filters. Several experiments were conducted and the results showed the feasibility of the concept of powering micro air vehicles using rf energy in the form of microwaves.

KEYWORDS: Micro Air Vehicles, Rectifier Antenna, Rectenna, Microwave Power, Schottky Barrier Diode

INFORMATION WARFARE TARGETING: PEOPLE AND PROCESSES

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Information Warfare (IW) targeting has long been a crucial, but unrecognized, part of military operations. From Sun Tzu's targeting of the enemy's will to fight, to today's information-centric warfare, it is those who have understood the techniques and applications of Information Warfare targeting who have most often prevailed. As critical as it is to success, it is a topic that is controversial, often misunderstood, and subject to various interpretations.

This thesis examines the IW targeting process, consisting of people, information, systems, and the interaction between the function of targeting and IW. In the Information Age, IW has been recognized as viable warfare area. However, IW targeting cannot be treated as traditional targeting utilized by other warfare areas. This thesis is intended to serve as a guide for the study of this topic and provides an instructional program designed to satisfy the requirement for a coherent instructional program on IW targeting.

IW targeting affects every facet of warfare and in turn is affected by these facets. In preparing for a future that calls for maximizing the effects while minimizing the effort, it is critical that the process be understood in order to remain effective.

KEYWORDS: Command and Control Warfare, Effects Based Targeting, Information Warfare, Information Operations, Targeting

MASTER OF SCIENCE IN SYSTEMS TECHNOLOGY

A METHODOLOGY FOR DEVELOPING TIMING CONSTRAINTS FOR THE BALLISTIC MISSILE DEFENSE SYSTEM

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The Department of Defense (DoD) is developing a Ballistic Missile Defense System (BMDS) based on a layered defense that employs complementary sensors, weapons, and C2 elements, integrated by software into a system-of-systems to engage and destroy threat ballistic missiles through all phases of flight. Inherent to the ultimate success of the BMDS will be the timely execution of the kill chain process against threat ballistic missiles.

In this thesis, the Unified Software Development Process (USDP) is applied, utilizing the BMDS as a case study to investigate a means to identify and validate timing behaviors and constraints of system-of-systems. In particular, the information exchange needed for processors to share, collaborate, fuse, and distribute sensor information in a distributed sensor network is examined, and modeling and simulation to provide insight into the timing aspects of interactions among subsystems comprising a system-of-systems is utilized. The case study will involve deriving and documenting system and software requirements, developing a test-ready model for representing the timing requirements, and then validating this model through the use of an OMNET++ simulation. The simulation will then be used to provide feedback to further refine the system requirements and the functional specifications of the subsystems.

KEYWORDS: Software Engineering, System-of-Systems, Ballistic Missile Defense System, BMDS, Sensor Fusion, Collaborative Fusion, Modeling, Simulation, OMNeT++, UML-RT, Real-Time Constraints, Software Requirements, Kill Chain, Timing Requirements, Unified Software Development Process, USDP

MASTER OF ARTS

**International Security and Civil-Military Relations
National Security Affairs
Security Studies**

MASTER OF ARTS IN INTERNATIONAL SECURITY AND CIVIL-MILITARY RELATIONS

U.S. INFLUENCE ON MILITARY PROFESSIONALISM IN THE PHILIPPINES

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Master of Arts in International Security and Civil-Military Relations-December 2003

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Second Reader: Harold A. Trinkunas, Department of National Security Affairs

The "special relationship" between the U.S. and the Philippines dates back to the beginning of the 20th Century. During this period, the U.S. played a significant role in the development of the Armed Forces of the Philippines (AFP). This thesis assesses the scope of U.S. influence in shaping military professionalism in the AFP. Military professionalism is essential in keeping positive civil-military relations and sustaining democracy. This thesis analyzes areas wherein the U.S. has potentially influenced military professionalism, namely the Philippine Military Academy, U.S. service academies, International Military Education and Training Program, and U.S.-Philippines Mil-to-Mil exercises. This study also discusses the degree of U.S. influence as the AFP deals with the post-Cold War era, the impact of the postmodern military, the Revolution in Military Affairs, and the global war on terrorism. Finally, this thesis presents a case study of the July 2003 failed mutiny. The study proposes that professionalism, or the lack thereof, is not an independent variable that determines whether or not the military will intervene in political affairs. Instead, it is a combination of strong institutions, solid oversight mechanisms, and highly professional armed forces that will preclude military adventurism and keep soldiers in the barracks.

KEYWORDS: Military Professionalism, Civil-Military Relations, Armed Forces of the Philippines, Mutiny, Revolution in Military Affairs, Postmodern Military, Expertise, Responsibility, Corporateness, Institutions, Legitimacy, Efficacy, Reequilibrium, Regime Capacity

LESSONS FROM THE 1999 ROUND OF NATO ENLARGEMENT

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In the spring of 1999, the Czech Republic, Poland, and Hungary all entered the North Atlantic Treaty Organization (NATO). These were the first former Warsaw Pact members to gain NATO accession since the Cold War ended with the dismemberment of the Soviet Union and the disintegration of the Warsaw Pact between 1989 through 1991. Now, seven more states are near the end of their accession talks. Barring unforeseen events, all are expected to join the alliance in 2004. This thesis studies the 1999 round of NATO accessants, particularly in the short time period since they achieved membership, and garners lessons for the new round of NATO candidates. This thesis notes other significant events that led to NATO's enlargement, including NATO's post-Cold War transformation and the war in the Balkans, along with courageous leadership. The thesis also summarizes common themes, identifies differences, and suggests solutions that could be implemented for the next round of NATO entrants, as well as for NATO as a whole, based on the three cases studied. Policy recommendations are made where appropriate.

KEYWORDS: NATO Enlargement, Civil-Military Relations, Poland, Hungary, Czech Republic, Defense Reform, Military Modernization, NATO, Military Alliance

INTERNATIONAL SECURITY AND CIVIL-MILITARY RELATIONS

THE CHANGING ROLE OF THE NATIONAL GUARD

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Since September 2001, the Global War on Terror (GWOT) has caused an unprecedented use of reserve forces (since the 1950s), in particular the Army National Guard. With GWOT being fought at home and abroad, the military and federal agencies are acting and fighting in unison to accomplish a variety of missions, from counter-terrorism to nation building.

Transformation is the process of changing the armed forces of the United States to become a more capable, less costly military force. Transformation is about providing a full spectrum of combat power to the nation in support of its foreign policy. Transformation is about leveraging technology to reduce the costs of military intervention.

Transformation of the Army National Guard (ARNG) concerns more than merely weapons systems and technology. It comprises more than whether or not equipment "cascades" to the Army National Guard from the Active Component (AC). Cascading is the official policy of moving equipment from Active Component units to Reserve Component units in the equipment fielding process for excess U.S. Army equipment. Transformation of the Army National Guard is about creating unique values to the community, the state, and the nation in crisis. Transformation will result in a change of the types of units the ARNG puts into the field.

KEYWORDS: Army National Guard, Pre-Strategic Engagement, Conflict Phase Operations, Post-Conflict Phase Operations

NATIONAL STRATEGY FOR COMBATING TERRORISM: PROSPECTS AND IMPLICATIONS

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Prior to the attacks of 9-11, the U.S. did not have a comprehensive national counterterrorism strategy. Terrorism was seen as one of many threats that could be addressed through policy directives and law enforcement. The trauma of 9-11 completely changed perceptions of the threat posed by terrorism. Overnight it came to be seen as the preeminent threat facing the U.S. President Bush declared a global war on terrorism and in less than a month U.S. forces were engaged in Afghanistan. The fight against terrorism is now seen as the primary focus of the military, but this expansion of roles is not without costs.

This thesis examines U.S. counterterrorism strategy before and after 9-11, with a focus on the role of the military. It evaluates changes in strategy and the implementation of strategy. It also reviews and assesses military roles in domestic and international counterterrorism efforts before and after 9-11. Finally, the thesis evaluates the implications of the expanded role of the military and prospects for success in the war on terror if the current strategy is pursued.

KEYWORDS: Terrorism, Counterterrorism, Al-Qaeda, Strategy, Readiness, Civil-Military Relations, Afghanistan, Iraq

MASTER OF ARTS IN NATIONAL SECURITY AFFAIRS

THE FEDERAL REPUBLIC OF GERMANY AND LEFT WING TERRORISM

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Master of Arts in National Security Affairs-December 2003

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From the late 1960s through the 1990s, West Germany confronted a domestic and international terrorist threat of considerable proportions: a threat that was unimaginative to many and a threat that caused considerable tribulations throughout the nation. This thesis analyzes how the transformation of radical student groups led to the ensuing left wing terrorism that arose within the fledgling democracy of the Bonn Republic, and the means by which the national government sought to suppress it. The thesis examines the evolution of official policy toward the terrorists and their supporting network, as well as the sometimes highly critical public reaction that these efforts inspired. It also considers the adaptations and reactions of the terrorists to official measures taken against them by the state. The thesis concludes by considering alternative measures, and offers recommendations and suggestions that might have better served the German government during its thirty-year ordeal against the Red Army Faction, June 2 Movement, and other left wing terrorists.

KEYWORDS: Terrorism, West Germany, Anti-Terrorist Legislation, Red Army Faction, Left Wing Terrorism, Baader-Meinhof

NATO'S MEDITERRANEAN DIALOGUE: CHALLENGES AND PROSPECTS

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Master of Arts in National Security Affairs-December 2003

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Donald Abenheim, Department of National Security Affairs

This thesis analyzes the challenges facing NATO's Mediterranean Dialogue. This Dialogue is an important part of NATO's adaptation to the post-Cold War security environment. It is an expression of the Alliance's policy of outreach and its cooperative approach to security. The new security challenges in the southern Mediterranean region—the potential for social and political instability, terrorism, the proliferation of weapons of mass destruction, economic disparities, demographic imbalances, and energy security—have begun to gain prominence in the Alliance, especially since the terrorist attacks of 11 September 2001. These challenges have enhanced NATO's significance as a vehicle to address security tasks in the southern Mediterranean region. NATO has distinctive military capabilities, and a well-established multinational organizational culture. This thesis recommends that the Dialogue be enhanced through coordination with European initiatives concerning the Mediterranean and greater involvement of the southern Mediterranean countries in the formulation and pursuit of goals and activities intended to foster peace and cooperation.

KEYWORDS: NATO, Mediterranean Dialogue, European Security

NATIONAL SECURITY AFFAIRS

COUNTERING TRANSNATIONAL TERRORISM IN SOUTHEAST ASIA WITH RESPECT TO TERRORISM IN INDONESIA AND THE PHILIPPINES

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Second Reader: CDR Douglas J. MacKinnon, USN, Department of Operation Research

Southeast Asia is experiencing tremendous changes, both politically and economically. Religious and ethnic issues have increased significantly. The move away from traditional to modern systems creates a degree of instability, eroding the existing system's socioeconomic and politico-psychological tenets, giving rise to counter-elites and opposition groups, and paving the way for a resurgence of racial terrorism and ethnic animosities.

Although unfamiliar with insurgencies, Southeast Asia, long considered the "Islamic periphery" owing to its moderate Islamic stance, pluralism and nationalism, is facing a more complex challenge. The root causes of terrorism, both domestic and international, are varied and complex. Some factors are essentially ideological, economical, and include religious and ethno-nationalistic extremism.

An adequate response requires counter-terrorist policies to interact with broader foreign policy. To be effective, counter-terrorism demands understanding the terrorist's psychology, motivation, and goals. Multilateral diplomatic efforts, such as the Association of Southeast Asia Nations (ASEAN) or the ASEAN Regional Forum (AFR), assist in forging substantive agreements that will enhance the sharing of information, tighten border agreements, and reinforce law enforcement cooperation. For example, the United States-ASEAN joint declaration on counter-terrorism, among other goals, pledges to share intelligence, block terrorist funds, tighten borders, and crack down on forged travel documents.

KEYWORDS: Southeast Asia, Islamic Periphery, Pluralism, Nationalism, Association of Southeast Nations, ASEAN, ASEAN Regional Forum, AFR

THE IMPACT OF U.S. FOREIGN POLICY ON THE STRUCTURE OF IRAN'S GOVERNMENT

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The potential for reform in the Iranian government appears to be very high, but the aggressive foreign policy position taken by the United States is actually helping the *mullahs* retain power. The United States has had an anti-Iranian foreign policy since 53 hostages were held by Iranian students for 444 days from 1979-1981. The election of Mohammed Khatami as President has signaled that the Iranian people desire a change in how their government operates: however, the office of the President does not have any significant power in Iran, because the constitution makes that position subordinate to the unelected position of the Supreme Leader. According to Jack Snyder, liberal regimes, like Khatami's presidency, lose domestic political strength when their country is under international pressure to change. Since the United States is the sole source of international pressure against Iran's government, the United States can help guide Iran's future. Relaxing the unilateral economic sanctions is one of many actions that start the process of reform in Iran.

KEYWORDS: Iranian Government, U.S. Foreign Policy

NATIONAL SECURITY AFFAIRS

THE EFFECTS OF CHINA ENTERING THE WORLD TRADE ORGANIZATION ON THE SOUTH KOREAN WIRELESS TELECOMMUNICATION INDUSTRY

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Master of Arts in National Security Affairs-December 2003

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This thesis investigates the effects of China entering the World Trade Organization on the South Korean wireless telecommunication industry. This thesis explores whether the South Korean wireless telecom industry will benefit from China's accession into the WTO. The working hypothesis of the thesis is that South Korean wireless telecom companies will receive far-reaching economic benefit from China's entry into the WTO. Additionally, this thesis explores the effects the entry in the WTO will have on China's telecom policy toward allowing foreign companies to own and operate parts of the network.

KEYWORDS: People's Republic of China, Wireless, Telecom, South Korea, 3G, CDMA, GSM, TD-SCDMA, China Mobile, China Unicom, China Telecom, China Netcom, MII, Telecommunications, China, WTO, World Trade Organization, R.O.K., PRC

THE RISE AND FALL OF *CHOSEN SOREN*: IT'S EFFECT ON JAPAN'S RELATIONS ON THE KOREAN PENINSULA

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Master of Arts in National Security Affairs-December 2003

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Second Reader: H. Lyman Miller, Department of National Security Affairs

The Korean Diaspora in Japan is a legacy of Japan's colonization of Korea in the first half of the 20th century and has always been the largest group of foreign residents in an otherwise ethnically homogenous Japan. A major issue is the role that Koreans in Japan play in supporting North Korea. Although a very small segment of the population, Koreans affiliated with the organization known as *Chosen Soren* have figured prominently in the triangular relationship between Japan, North Korea, and South Korea over the past 50 years. During the Cold War, *Chosen Soren* activities in support of North Korea severely strained Japan-South Korea relations, which were already plagued by lingering animosity from the colonial period. For many years, *Chosen Soren* was the conduit through which Japan and North Korea attempted to expand trade and eventually establish formal diplomatic ties. However, Japan-North Korea relations have deteriorated in the post-Cold War era due to North Korea's growing military threat to Japan, and most recently, North Korea's admission that it had been systematically kidnapping Japanese citizens. Studying the history of *Chosen Soren* will result in a better understanding of the complexities underlying Japan's current foreign policy toward North Korea.

KEYWORDS: Koreans in Japan, *Chosen Soren*, *Chongryun*, Japan-North Korea Relations, Japan-South Korea Relations

CHINESE MILITARY MODERNIZATION AND THE FUTURE OF TAIWAN

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The potential military capabilities of the People's Republic of China (PRC) carry tremendous implications for the Republic of China (ROC) on Taiwan. The PRC's military modernization efforts are quickly eroding

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the ROC's qualitative military advantage. As the PRC modernizes, the possibility for a peaceful reunification diminishes. However, if it chooses an aggressive solution for reunification, the PRC recognizes that it may have to contend with the United States coming to Taiwan's aid.

This thesis addresses the PRC's efforts to modernize its armed forces. Since 1985, Beijing has initiated a dedicated process of preparing the People's Liberation Army (PLA) to fight future wars. Through detailed analysis of U.S. military campaigns in the Middle East and the Balkans, the PRC has implemented new doctrine and equipment to help transform the PLA into a superior fighting force. As it modernizes, the PRC is developing strategies to force Taiwan's reunification with the mainland. Also, the PRC is developing asymmetric methods to defeat the possible presence of U.S. forces in the Taiwan Strait. The modernization of the PLA is dedicated towards achieving both of these goals.

KEYWORDS: People's Republic of China, Republic of China on Taiwan, Taiwan Strait, PLA, Military Modernization

AMPHIBIOUS AND SPECIAL OPERATIONS IN THE AEGEAN SEA 1943-1945: OPERATIONAL EFFECTIVENESS AND STRATEGIC IMPLICATIONS

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Master of Arts in National Security Affairs-December 2003

Master of Science in Defense Analysis-December 2003

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The Aegean Sea during the Second World War drew the attention of both the Allies and the Axis. However, although historians have chronicled the fall of Greece and Crete in the spring of 1941, little attention has been given to the war in the Aegean after 1941. From the early days of the Mediterranean war, Churchill especially believed that the elimination of the Italian occupation of the Dodecanese Islands would facilitate British operations in the Eastern Mediterranean and help to convince Turkey to enter the war on the Allied side. When, in the autumn of 1943, Churchill sought to realize these goals, he succeeded only in creating an operational disaster and provoking a minor crisis between the Western Allies.

For the British, the Italian surrender of September 1943 provided a window of opportunity to thrust through the Aegean into Greece and the Balkans. The Americans firmly rejected Churchill's proposals for operations in the Eastern Mediterranean as designed to serve British imperial interests, rather than those of the rapid defeat of Germany. Despite failure to secure U.S. support, Churchill nevertheless proceeded with operations against Kos and Leros, with disastrous results. However, the British were more fortunate in conducting special operations in the Aegean and against Crete in 1943 and 1944 to the end of the war. This thesis follows the main events that affected the Aegean Sea in the war, stressing issues of inter-allied relations, peripheral strategy, tactical solutions to strategic problems, and special operations.

KEYWORDS: 1943-1945, Aegean Sea, Dodecanese Islands, British Interests, Special Operations, Inter-Allied Relations

DEMOGRAPHICS: THE DOWNFALL OF SAUDI ARABIA

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Threats to Saudi Arabia have historically been categorized as external, reference immediate neighbors, and internal, via conservative Islamic opposition groups. The United States, because of its security arrangement, has guaranteed the sovereignty of Saudi Arabia. Opposition groups within the Kingdom, while attracting recent attention, are placated through concessions to the Ulema and direct payment. However, primary destabilization of the Saudi regime today is due to stress placed upon the Saudi economy

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and ruling structure by an unprecedented population growth within the Kingdom over the last two decades. The argument is that growth in the Kingdom has rapidly outstripped the regime's ability to provide for it, undermining a key pillar of the Royal Family's ruling legitimacy. This thesis explores stress placed upon the Saudi regime through its population growth. Due to effects of relative deprivation, the Saudi populace is demanding government participation, calling to question personal regime expenditures, and the motivations of regime foreign policy, especially in relation to the United States. This study will briefly address courses of action available to the Royal Family, current effects of population growth upon the Saudi economy, and the regional and international consequences of a failed Saudi government.

KEYWORDS: Rentier State, Social Pact, U.S.-Saudi Relations, Economic-Political Reform, Population Growth, Regime Corruption, Resource Based Economy

NATO'S PRAGUE CAPABILITIES COMMITMENT: ORIGINS AND PROSPECTS

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This thesis analyzes the origins and prospects of NATO's Prague Capabilities Commitment (PCC). Following the end of the Cold War in 1989-1991, NATO's conventional military capabilities rose in importance as the Allies undertook crisis management operations in the Balkans. Capability shortcomings, particularly among the European Allies, led NATO in 1999 to approve a Defense Capabilities Initiative (DCI). However, the DCI's disappointing results, the terrorist attacks on the United States on 11 September 2001, the subsequent American military action in Afghanistan in cooperation with NATO Allies, the leading role of NATO Allies in the International Security Assistance Force in Kabul, and other factors convinced the Allies to make a new effort to improve capabilities. The Allies decided at the November 2002 Prague Summit to endorse the PCC. The PCC's prospects for success may not be greater than those of the DCI unless the European Allies commit greater resources, pool assets in multinational frameworks, pursue specialization in military missions, and modify their procurement priorities. Moreover, the PCC's success hinges on closely related initiatives: the NATO Response Force and the new command structures.

KEYWORDS: Prague Capabilities Commitment, Balkans, Defense Capabilities Initiative

CENTRAL ASIAN DRUG TRAFFICKING DILEMMA

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Tajikistan, a state that is completely landlocked, consists of very rough terrain that is comprised of mountains, cliffs, and glaciers. There are very few transportation links through the area which gives Tajikistan limited access to neighboring countries. Security problems resulting from the increasing flow of narcotics illegally smuggled across the 1200 km Tajikistan-Afghanistan border have become critical in understanding the nature of political instability within Central Asia. This thesis focuses on the growing trend of drug trafficking and use throughout Afghanistan and Tajikistan and the porous border the two countries share. It establishes why the northern route in Afghanistan has gained importance and why drug trafficking is reaching all-time high levels. Russia provides the border security in Tajikistan through the use of its Federal Border Service. Unfortunately, corruption within the government has not allowed the country to overcome its drug trafficking and use dilemma. The United States provides little assistance to the region and does not have any plans to assist in the near future. The thesis concludes that Central Asia,

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Russia, and the United States need to cooperate and help stabilize the region in order to slow the transit of drugs through the area.

KEYWORDS: Central Asia, Tajikistan, Russia, Afghanistan, Drug Trafficking, Border Security

LAND REFORM AND CONFLICT RESOLUTION IN COLOMBIA

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One of the leading arguments explaining the current rural conflict in Colombia is that it stems from deeply rooted peasant grievances over lack of land. As is true in much of Latin America, Colombia has one of the highest levels of inequality of land ownership in the world. Yet, in over four decades worth of land titling effort, INCORA, Colombia's national land reform agency, has been unable to change the overall high concentration of land ownership. This thesis examines to what effect, if any, a redistributive land reform policy implemented amid the ongoing rural conflict would have on its resolution.

While social scientists have developed a multitude of theoretical explanations of "why peasants rebel," little attention has been given to how land reform implemented during intra-state conflict is to resolve peasant insurgencies. Devoid of a theoretical framework, policymakers have looked towards two well-known cases of land reform in South Vietnam and El Salvador to base much of their decision making on the merits of land reform in the Colombian case. Yet this thesis finds that these two cases do not provide sufficient evidence to suggest a similar failure of land reform in the Colombian case. Furthermore, this thesis confirms that there is a strong historical nexus between land and conflict in Colombia, and since the mid-1990s, the intensification of the rural conflict resulted from: (1) the phenomena of "reverse land reform," where narco-traffickers purchased vast sums of land attempting to launder illicit drug profits; (2) an increase in rural income inequality; and (3) a significant shift from illicit coca cultivation in Bolivia and Peru to Colombia.

Ultimately, this thesis finds that as a "stand alone" policy, redistributive land reform will not only be a difficult agenda item for Colombia's president to find political support for, but its very implementation will be violently contested by guerrillas, paramilitaries, and narco-traffickers. This thesis concludes by offering potential alternative approaches or "paths" that make redistributive land reform feasible in Colombia, with special emphasis on a rural pacification, asset forfeiture, and post-conflict requirements.

KEYWORDS: Colombia, Land Reform, Conflict Resolution, Asset Forfeiture, FARC, Paramilitaries, Reverse Land Reform, South Vietnam, El Salvador, ANUC, Pacification, Narco-Terrorism, Narco-Trafficking

DEVELOPING MODALITIES OF COOPERATION BETWEEN NATO AND THE EUROPEAN UNION

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In December 1998, France and the United Kingdom called for the European Union (EU) to develop "the capacity for autonomous action, backed up by credible military forces, the means to decide to use them, and a readiness to do so." This was the beginning of the EU's European Security and Defense Policy (ESDP), because this goal was endorsed by the EU as a whole at Cologne in June 1999. The EU's ESDP immediately ignited controversy in relations between the EU and NATO. However, it was soon discovered

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that the development of the ESDP could not be easily accomplished without recourse to NATO assets and expertise. The EU has accordingly established various mechanisms for consultation, facilitating the development of the ESDP not as an entirely independent policy, but rather one pursued in cooperation with NATO. Furthermore, in its current form, the underlying principles of the ESDP have not been driven primarily by the need for independent defense capabilities, which seem remote at the present time as far as the most demanding contingencies are concerned, but rather by the need to be able to act when and if the United States and NATO decide to step aside. The success of the ESDP may well be influenced by the progress in cooperation between the EU and NATO, in view of their overlapping but distinctive memberships and purposes.

KEYWORDS: European Union, NATO, Cooperation, European Security and Defense Policy, Modalities, Berlin Plus

DETERRENCE AND THE NATIONAL SECURITY STRATEGY OF 2002: A ROUND PEG FOR A ROUND HOLE

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The National Security Strategy of 2002 suggests that the United States has determined that when faced with the threat of attacks from actors in possession of weapons of mass destruction, a strategy of deterrence is not appropriate. The prospect of absorbing another attack on the caliber of the attacks of September 11, 2001 is unacceptable. As a result, the United States must either abandon the strategy of deterrence for most security challenges or it must adopt a new concept of deterrence. This thesis suggests that the practice of a new concept of deterrence, in which the United States threatens punishment to an adversary for actions short of military attacks against the United States, would address security challenges across the spectrum of threats. Under this concept, preemptive attacks and preventive war constitute possible examples of deterrence failures. This paper outlines the parameters of the new deterrence situation, the requirements for success in pursuing this strategy, and the challenges to its implementation.

KEYWORDS: Deterrence, Coercion, Compellence, Preemption, Preventive War, National Security Strategy, Quadrennial Defense Review, Weapons of Mass Destruction

ARM SALES TO LATIN AMERICA

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Latin America is experiencing unprecedented peace and stability because democracy has replaced the authoritarian regimes of the past. The Clinton Administration decided in 1997 to lift the arm sales ban to Latin America after a twenty-year moratorium. This recent change in U.S. arm sales policy has renewed a growing concern among critics that an influx of U.S. weapons to the region will lead to an arms race. This thesis argues that an arms race is not occurring in Latin America today. Three possible explanations will be explored to explain the presence or absence of arms races in Latin America. They are: democratic peace and complex interdependence, economic determinants of defense expenditures, and U.S. arms sales policy. Two traditional rival dyads, Brazil/Argentina and Peru/Ecuador, will be applied to theoretical bases for international arms races as well as U.S. foreign policy. The major conclusion of this thesis is that U.S. foreign policy neither supports nor prevents arms races, and economic determinants of defense expenditures offer mixed results at best. The best possible explanation for why an arms race is not occurring in Latin America today is the presence of democratic peace and complex interdependence.

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KEYWORDS: Latin America, Arm Sales, Democratic Peace, Complex Interdependence, U.S. Foreign Policy, Brazil, Argentina, Peru, Ecuador, Defense Expenditures, Arms Race

IMPLICATIONS OF SINO-AMERICAN STRATEGIC COMPETITION ON SOUTHEAST ASIA'S POST-COLD WAR REGIONAL ORDER

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Southeast Asia is a maritime crossroad and an arena of strategic great power interaction. The study of international politics after the Cold War has rediscovered the importance of regional interaction as the framework for understanding a country's security strategies and the great powers' impact on specific regions. A review of various theories reveals the revival of geopolitics in theoretical constructions and policy formulations. This thesis reviews United States-China relations as the independent variable. The U.S. grand strategy has been consistent since the first Bush administration, namely, to prevent the rise of a peer competitor. The American instruments in pursuit of its strategy are derived from its nature as a maritime power. China is a continental power that is recently expanding seaward and re-emerging as East Asia's indispensable power. China's success in promoting its vision of order in maritime Southeast Asia will potentially undermine America's influence. Southeast Asia's regional order, the dependent variable, is dynamic when viewed from its two dimensions: time and space. Time refers to historical cycles, while space refers to the diverse views in dealing with the major powers, i.e., regional autonomy, a balance of engagement among the great powers and, since the 1990s, stronger engagement only with Northeast Asia. This thesis argues that regional identity is the primary driver of Southeast Asia's strategy for regional order.

KEYWORDS: Association of Southeast Asian Nations, ASEAN, ASEAN Regional Forum, ARF, ASEAN+3, ASEAN+China, China Foreign Relations, East Asia, East Asia Economic Caucus, East Asia Community, Grand Strategy, Maritime, People's Liberation Army, Southeast Asia, Treaty of Amity and Cooperation in Southeast Asia, Treaty of Southeast Asia Nuclear Weapons Free Zone, United States Foreign Relations, Zone of Peace, Freedom and Neutrality, ZOPFAN

EASTERN EUROPE AND THE 2002-2003 IRAQ CRISIS

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In the 2002-2003 Iraq crisis, most Eastern European countries aimed first of all to maintain positive relations with their main strategic partner, the United States. This priority was closely connected with NATO, Eastern Europe's preferred collective defense organization. Eastern European governments were concerned that if they supported the position of France and Germany regarding the Iraq crisis, the greater U.S. frustration with present and future European NATO partners might have eventually led to a weakening of the NATO collective defense commitment and a reduction of U.S. interest in Europe. This outcome would have signified the disappearance of the security guarantee that most Eastern European countries have been seeking since the beginning of the 1990s and that they would prefer to rely on in the long term. Eastern European countries are prepared to make significant efforts to uphold NATO's effectiveness. Indeed, the main mission of Eastern Europe in the future may be to keep the United States effectively engaged in Europe and to sustain NATO's cohesion and relevance. It is possible that NATO will survive in the long term partly because Eastern European countries have enthusiastically embraced this alliance.

KEYWORDS: NATO, European Union, Eastern Europe

MASTER OF ARTS IN SECURITY STUDIES

ASEAN+3: THE INSTITUTIONALIZATION OF ASIAN VALUES

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In the wake of the 1997-1998 Asian economic crisis, the leaders of East Asia came together to establish the ASEAN+3 forum: a forum to accommodate thirteen countries, heterogeneous in nature, with diverse political, economic, social, and cultural backgrounds. Some political scientists interpreted the establishment of the ASEAN+3 as the emergence of a new form of regionalism. This new regionalism represents a clear break from the region's strong history of multilateralism. The countries of East Asia have also been exploring ways of expanding intra-regional trade, including the establishment of regional trade agreements (RTAs) such as the ASEAN+3, planning to establish an East Asia Free Trade Area (EAFTA), as well as negotiating bilateral trade agreements (BTAs). This thesis hypothesizes that the philosophy of Asian values and the 1997-1998 Asian economic crisis stimulated the creation of the ASEAN+3. It is important to understand this philosophy for it is likely to influence the ASEAN+3 in the future. The understanding of whether the Asian economic crisis spurred the creation of the ASEAN+3 is crucial to determine whether the ASEAN+3 will play an economic role in the region.

KEYWORDS: ASEAN+3, Asian Values, Asian Economic Crisis, Asian Economic Development Model, East Asia Free Trade Area, EAFTA, Crony Capitalism, ASEAN Way, Politics of Resentment

RECONCILIATION IS THE BEST SOLUTION FOR CONFLICT IN ACEH

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The history of the conflict in Aceh began in the pre-colonial era, during which the Acehnese struggled to fight the Dutch for more than three centuries. The conflict between the Indonesian central government and the GAM (Free Aceh Movement) has continued for the last three decades. The GAM has been able to develop and improve its struggle using conventional and modified guerilla tactics. The GAM leadership in exile utilizes central government and military weaknesses to their advantage, including the collapse of the strong authoritarian government in 1998 and the independence of East Timor afterward. They succeed in exploiting the populace's grievances in order to create enemy image of Indonesian colonialism in Aceh. The central government and military responses to confront conflict in Aceh have never changed much, and the military has always been the primary option. Though military operations have been able to suppress the rebels, they have also had a negative impact on Acehnese society due to weaknesses within the military, such as less professional soldiers and a limited budget. Dialogue between the GAM and the central government took place in 1999, but ended in failure in 2003, and the central government launched an integrated operation. As the rebel movement escalates, military action that led to the integrated operation was necessary and unavoidable to restore the government system and public law and order. Nevertheless, with the lessons learned from the past rebellion, the merely military option would not be sufficient to win the war in Aceh. Aceh needs more comprehensive policies, starting with reconciliation followed by economic and governance rehabilitations. The required prerequisites for reconciliation are ending the hostilities between leaders and giving more incentives for rebels in the field to surrender. The latter needs the trust that can be built by granting amnesty or sentence reduction to ex-rebels. At the same time, internal

improvements should also be made within the military to foster better performance. Reconciliation and societal development do not need to halt military action as long as the security of the Acehnese and public order are still threatened.

KEYWORDS: Aceh, GAM, Free Aceh Movement

ISLAM AND ECONOMIC GROWTH IN MALAYSIA

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Muslim countries are often thought of as culturally backward, authoritarian, misogynistic, and poor in economic performance. The teachings of Islam, however, prescribe democratic governance and free-market economics. While Muslims, as a whole, have tremendous economic potential, many Muslims are among the world's poorest and least educated. Corrupt autocratic leaders have attempted to capitalize on the Muslim dream of building a grand society, but owing to these manipulations and leaders' insincerity, their efforts have yielded little fruitful results.

This thesis discusses nation building by fusing Islam, pluralism, democracy, and modernity. It argues that Malaysia's religious tolerance and adherence to western development models has fostered economic growth since its independence. Clearly, practicing Islam while pursuing social, economic, and political development, is a suitable model, especially for heterogeneous societies.

The thesis offers a model, Malaysia, as a unique example of the influence of Islamic universalism, multiculturalism, and Islamic modernism to improve economic growth. The thesis depicts the evolutionary transformation of Malay-Islam, from its settlement to its status as a model for Muslims and Third World countries. This thesis illustrates the compatibility of Islam and modernity in economic development.

KEYWORDS: Islam, Economic Growth, Affirmative Action Program, Malaysia's Development Model, Islamic Universalism, Multiculturalism, Islamic Modernism, Islam and Modernity

THE POLITICS OF MERITOCRACY IN MALAYSIA

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The effort to achieve development in Malaysia raises the question of how to develop a country where inequality between racial groups is significant. Of the various efforts made to achieve this goal, the most important is the New Economic Policy (NEP), a corrective policy designed to assist the Malays in socio-economic development. In essence, this was an affirmative action policy for a majority of the population that was economically behind the minority Chinese-Malaysians.

However, the racial-oriented policy cannot respond effectively to the new problem of intra-racial inequality, which results from the policy itself. Although sustained through the rhetoric of racial equality, the NEP has created other implications, namely the intra-racial inequality and an uncompetitive community.

In order to develop a more competitive economy, a meritocratic system emphasizing personal contributions rather than privileges should be investigated. This paper weighs the merits of affirmative action policies and meritocracy as approaches to national integration in Malaysia, and subsequently towards Malaysia's goal to be a fully industrialized country by 2020.

This study finds that, due to the continuance of inter-racial disparity, Malaysian society is not prepared to implement total meritocracy within the next few years. The thesis identifies various steps needed to "level the playing field," which will require firm decisions by the government and sacrifices by the population.

KEYWORDS: Meritocracy, Affirmative Action Policies, New Economic Policies, Equality of Opportunity, National Integration

POTENTIAL FOR CONFLICT IN THE SPRATLY ISLANDS

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This thesis examines the potential for conflict in the Spratly Islands, and determines whether the Declaration of Conduct of Parties in the South China Sea, signed between China and ASEAN on 4 November 2002, together with ASEAN's multilateral confidence building measures and mechanisms, are able to prevent or manage this dispute. China, Taiwan, Vietnam, the Philippines, Malaysia, and Brunei have laid claims on some or all of the islands. Many scholars have argued that the economic and strategic value of the Spratly Islands underlay competing claims in the Spratlys. In response to this, ASEAN is using Track I and II diplomacies to pursue solutions and confidence-building measures to prevent the dispute from escalating into a conflict in the region. All claimants except Taiwan are signatories. Can this dispute be resolved without Taiwan's participation? This study concludes that this is a multilateral dispute that needs to be solved multilaterally by all the claimants. However, unless all the signatories adhere to the principles of the Declaration of Conduct of Parties in the South China Sea, no guarantee exists that this can prevent claimants from taking unilateral actions.

KEYWORDS: Spratlys, Spratly Islands, South China Sea, Declaration of Conduct of Parties, ASEAN, Track I and II Diplomacies, Multilateral, Confidence-Building Measures

THE CAUSES AND PROSPECT OF THE SOUTHERN PHILIPPINES SECESSIONIST MOVEMENT

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The Southern Philippines secessionist movement has developed once again into a major security concern of the Republic of the Philippines. The hostilities have taken a heavy toll on the nation's human and physical resources and hurt to the nation's economy. Likewise, the rebellion has afflicted both regional and global security because of the reported linkages of the Moro Islamic Liberation Front and the Abu Sayyaf with the Islamic militant groups. The United States has already directly intervened in the Philippine counter-terrorism campaign, by providing military assistance and deploying American combat troops in Mindanao and the Sulu archipelago.

Peace remains elusive. Various administrations have used combinations of military, political, diplomatic, and socio-economic instruments to resolve the conflict, but the violence persists. The presidential regime of Fidel Ramos appeared to have achieved a breakthrough in finding a lasting solution by assiduously instituting the policies of decentralization and regional autonomy. Although the government has settled the dispute with the Moro National Liberation Front (MNLF), other equally dangerous groups, the Moro Islamic Liberation Front (MILF) and the Abu Sayyaf, have emerged espousing independence from the Republic of the Philippines.

This thesis will analyze the issues and prospects surrounding the Muslim secessionist movements in the Philippines and will examine the responses to resolve the grievances of the Muslim Filipinos.

KEYWORDS: Autonomous Region of Muslim Mindanao, ARMM, Moro National Liberation Front, MNLF, Moro Islamic Liberation Front, MILF, Abu Sayyaf

SECURITY STUDIES

GENOCIDE IN RWANDA: THE INTERPLAY OF HUMAN CAPITAL, SCARCE RESOURCES, AND SOCIAL COHESION

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In 1994, the Rwandan genocide stunned the international community. The brutality of its execution was incomprehensible and defied one's wildest imagination. Many authors contend that ethnic extremism coupled with political manipulation were the primary factors behind this tragedy. Yet, to oversimplify the cause of this tragedy makes one blind to the complicated nexus that generated the outcome. Even though this genocide was quick in its execution, the events that lead to this massacre took years to unfold. The first violent clash between the Hutu and the Tutsi began in 1959. Historically, the relationship between Hutus and Tutsis was harmonious until the advent of Belgian colonialism, which imposed a system that benefited the Tutsi and victimized the Hutu. The Hutu disaffection with the system did not immediately translate into conflict. It was only when they were educated about their misfortunes and inequities that they rose up violently against the injustice. Unfortunately, they perpetrated a ghastly butchery of innocents. The nature of the Rwandan society, where people lived close to each other, knew their neighbors very well, and had an element of blind obedience toward authority, served the agenda of the genocide perpetrators. These factors, when compounded with intense competition for limited resources, eventually led to the aforementioned tragedy.

KEYWORDS: Genocide, Human Capital, Education, Ethnic Conflict, Post-Conflict, Resources, Land Pressure, Land Tenure, Social Cohesion and Social Capital

PERPETUAL WAR: THE PHILIPPINE INSURGENCIES

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The Philippines is afflicted by two of the longest running insurgencies in the world. The communist New People's Army (NPA) have been fighting to establish a Marxist-Leninist-Maoist state since 1969. The Muslim separatist movements, represented by the Moro National Liberation Front (MNLF) and a break away faction, the Moro Islamic Liberation Front (MILF), have been fighting a rebellion since 1973. Although the government and the MNLF signed a peace agreement in 1996, violence continues to erupt on the island of Mindanao, where the Muslim population is concentrated. The resources spent on these insurgencies are a heavy burden on the Philippine economy, and the unstable peace and order conditions created by it have kept the country's economic performance far below that of its regional neighbors. These conflicts could have been settled earlier and the Philippines could have devoted more time and resources to resolving the economic causes which drove the insurgencies in the first place.

Why these conflicts managed not only to survive, but to recover, is the subject of this thesis. How the government responded to these internal challenges, what strategy the rebels adapted, and the intervention of third parties partly explain why these insurgencies have been active for more than three decades.

KEYWORDS: Conflict Termination, Counterinsurgency, Post-Colonial Development

STRATEGIC INTERACTIONS BETWEEN THE UNITED STATES AND NORTH KOREA: DETERRENCE OR SECURITY DILEMMA?

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Worried about the regional and global consequences of a nuclear North Korea, the U.S. government has pursued both diplomacy and coercion to stop North Korea's nuclear weapons program. However, as of December 2003, U.S. policies appear to have failed, since North Korea has become the ninth nuclear weapons state. Since North Korea's motives have been ambiguous from the very beginning, the United States has had difficulty in developing strategies that would effectively address North Korea's motives and curtail its nuclear ambitions. This thesis argues that although North Korea has ambitious motives, its nuclear efforts are mostly reactions driven by insecurity. Coercive policies towards North Korea increase its insecurity and compel it to resort to nuclear weapons. The United States perceives North Korea's reactions as blackmail since North Korea combines its economic and political problems with its security concerns. Mutual distrust and insecurity, which is mostly a result of misperceptions, creates a security dilemma, a vicious spiral in which the security interests of the two states are mutually threatened by each other's self-protection aspirations. Cooperation, rather than coercion, is believed to work better in such cases. However, both sides should separate nuclear issues from other issues to reduce mutual distrust and misperceptions and to achieve effective cooperation.

KEYWORDS: North Korea's Nuclear Program, U.S. Policies Towards North Korea, Deterrence, Security Dilemma

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